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Ethoxyquin (6-ethoxy-1,2-dihydro-2,2,4-trimethylquinoline): Pesticide Registration Standard

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This document contains information regarding reregistration of pesticide products containing 6-ethoxy-1,2-dihydro-2,2,4-trimethylquinoline (Ethoxyquin), including how to register under a registration standard, regulatory position and rationale, and summaries of data requirements and data gaps. Also included is a bibliography containing citations of all studies reviewed by EPA in arriving at the positions and conclusions contained in the standard.

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Ethoxyquin

Pesticide Registration Standard

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ETHOXYQUIN

Pesticide Registration Standard

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I

HOW TO REGISTER UNDER A REGISTRATION STANDARD

Organization of the Standard
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Organization of the Standard

This first chapter explains the purpose of a Registration Standard and summarizes the legal principles involved in registering or re-registering under a Standard. The second chapter sets forth the requirements that must be met to obtain or retain registration for products covered by this particular Registration Standard. In the remaining chapters, the Agency reviews the available data by scientific discipline, discusses the Agency's concerns with the identified potential hazards, and logically develops the conditions and requirements that would reduce those hazards to acceptable levels.

Purpose of the Standard

Section 3 of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) provides that "no person in any State may distribute, sell, offer for sale, hold for sale, ship, deliver for shipment, or receive (and having so received) deliver or offer to deliver, to any person any pesticide which is not registered with the Administrator [of EPA]." To approve the registration of a pesticide, the Administrator must find, pursuant to Section 3(c)(5) that:

"(A) its composition is such as to warrant the proposed claims for it;
(B) its labeling and other material required to be submitted comply with the requirements of this Act;
(C) it will perform its intended function without unreasonable adverse effects on the environment; and
(D) when used in accordance with widespread and commonly recognized practice it will not generally cause unreasonable adverse effects on the environment."

In making these findings, the Agency reviews a wide range of data which registrants are required to submit, and assesses the risks and benefits associated with the use of the proposed pesticide. But the established approach to making these findings has been found to be defective on two counts:

First, EPA and its predecessor agency, the United States Department of Agriculture (USDA), routinely reviewed registration applications on a 'product by product' basis, evaluating each product-specific application somewhat independently. In the review of products containing similar components, there was little opportunity for a retrospective review of the full range of pertinent data available in Agency files and in the public literature. Thus the 'product by product' approach was often inefficient and sometimes resulted in inconsistent or incomplete regulatory judgments.

Second, over the years, as a result of inevitable and continuing advances in scientific knowledge, methodology, and policy, the data base for many pesticides came to be considered inadequate by current scientific and regulatory standards. Given the long history of pesticide regulation in several agencies, it is even likely that materials may have been lost from the data files. When EPA issued new requirements for registration in 1975 (40 CFR 162) and proposed new guidelines for hazard testing in 1978 (43 FR 29686, July 10, 1978 and 43 FR 37336, August 2, 1978), many products that had already been registered for years were being sold and used without the same assurances of human and environmental safety as was being required for new products. Because of this inconsistency, Congress directed EPA to re-register all previously registered products, so as to bring their registrations and their data bases into compliance with current requirements. (See FIFRA Section 3(g)).

Facing the enormous job of re-reviewing and calling-in new data for the approximately 35,000 current registrations, and realizing the inefficiencies of the 'product by product' approach, the Agency decided that a new, more effective method of review was needed.

A new review procedure has been developed. Under it, EPA publishes documents called Registration Standards, each of which discusses a particular pesticide active ingredient. Each Registration Standard summarizes all the data available to the Agency on a particular active ingredient and its current uses, and sets forth the Agency's comprehensive position on the conditions and requirements for registration of all existing and future products which contain that active ingredient. These conditions and requirements, all of which must be met to obtain or retain full registration or re-registration under Section 3(c)(5) of FIFRA, include the submission of needed scientific data which the Agency does not now have, compliance with standards of toxicity, composition, labeling, and packaging, and satisfaction of the data compensation provisions of FIFRA Section 3(c)(1)(D).

The Standard will also serve as a tool for product classification. As part of the registration of a pesticide product, EPA may classify each product for "general use" or "restricted use" [FIFRA Section 3(d)]. A pesticide is classified for "restricted use" when some special regulatory restriction is needed to ensure against unreasonable adverse effects to man or the environment. Many such risks of unreasonable adverse effects can be lessened if expressly-designed label precautions are strictly followed. Thus the special regulatory restriction for a "restricted use" pesticide is usually a requirement that it be applied only by, or under the supervision of, an applicator who has been certified by the State or Federal government as being competent to use pesticide safely, responsibly, and in accordance with label directions. A restricted-use pesticide can have other regulatory restrictions [40 CFR 162.11(c)(5)] instead of, or in addition to, the certified applicator requirement. These other regulatory restrictions may include such actions as seasonal or regional limitations on use, or a requirement for the monitoring of residue levels after use. A pesticide classified for "general use," or not classified at all, is available for use by any individual who is in compliance with State or local regulations. The Registration Standard review compares information about potential adverse effects of specific uses of the pesticide with risk criteria listed in 40 CFR 162.11(c), and thereby determines whether a product needs to be classified for "restricted use." If the Standard does classify a pesticide for "restricted use," this determination is stated in the second chapter.

Requirement to Re-register Under the Standard

FIFRA Section 3(g), as amended in 1978, directs EPA to re-register all currently registered products as expeditiously as possible. Congress also agreed that re-registration should be accomplished by the use of Registration Standards.

Each registrant of a currently registered product to which this Standard applies, and who wishes to continue to sell or distribute his product in commerce, must apply for re-registration. His application must contain proposed labeling that complies with this Standard.

EPA will issue a notice of intent to cancel the registration of any currently registered product to which this Standard applies if the registrant fails to comply with the procedures for re-registration set forth in the Guidance Package which accompanies this Standard.

"Product Specific" Data and "Generic" Data

In the course of developing this Standard, EPA has determined the types of data needed for evaluation of the properties and effects of products to which the Standard applies, in the disciplinary areas of Product Chemistry, Environmental Fate, Toxicology, Residue Chemistry, and Ecological Effects. These determinations are based primarily on the data Guidelines proposed in 1978 (43 FR 29696, July 10, 1978, and 43 FR 37336, August 22, 1978), as applied to the use patterns of the products to which this Standard applies. Where it appeared that data from a normally applicable Guidelines requirement was actually unnecessary to evaluate these products, the Standard indicates that the requirement has been waived. On the other hand, in some cases studies not required by the Guidelines may be needed because of the particular composition or use pattern of products the Standard covers; if so, the Standard explains the Agency's reasoning. Data guidelines have not yet been proposed for the Residue Chemistry discipline, but the requirements for such data have been in affect for some time and are, the Agency belives, relatively familiar to registrants. Data which we have found are needed to evaluate the registrability of some products covered by the Standard may not be needed for the evaluation of other products, depending upon the composition, formulation type, and intended uses of the product in question. The Standard states which data requirements apply to which product categories. (See the second chapter.) The various kinds of data normally required for registration of a pesticide product can be divided into two basic groups:

(A) data that is " product specific ," i.e., data that relates only to the properties or effects of a product with a particular composition (or a group of products with closely similar composition); and

(B) "generic" data that pertains to the properties or effects of a particular ingredient, and thus is relevant to an evaluation of the risks and benefits of all products containing that ingredient (or all such products having a certain use pattern), regardless of any such product's unique composition.

The Agency requires certain "product specific" data for each product to characterize the product's particular composition and physical/chemical properties (Product Chemistry), and to characterize the product's acute toxicity (which is a function of its total composition). The applicant for registration or re-registration of any product, whether it is a manufacturing-use or end-use product, and without regard to its intended use pattern, must submit or cite enough of this kind of data to allow EPA to evaluate the product. For such purposes, "product specific" data on any product other than the applicant's is irrelevant, unless the other product is closely similar in composition to the applicant's. (Where it has been found practicable to group similar products for purposes of evaluating, with a single set of tests, all products in the group, the Standard so indicates.) "Product specific" data on the efficacy of particular end-use products is also required where the exact formulation may affect efficacy and where failure of efficacy could cause public health problems.

All other data needed to evaluate pesticide products concerns the properties or effects of a particular ingredient of products (normally a pesticidally active ingredient, but in some cases a pesticidally inactive, or "inert," ingredient). Some data in this "generic" category are required to evaluate the properties and effects of all products containing that ingredient [e.g., the acute LD-50 of the active ingredient in its technical or purer grade; see proposed 40 CFR 163.81-1(a), 43 FR 37355].

Other "generic" data are required to evaluate all products which both contain a particular ingredient and are intended for certain uses (see, e.g., proposed 40 CFR 163.82-1, 43 FR 37363, which requires subchronic oral testing of the active ingredient with respect to certain use patterns only). Where a particular data requirement is use-pattern dependent, it will apply to each end-use product which is to be labeled for that use pattern (except where such end-use product is formulated from a registered manufacturing-use product permitting such formulations) and to each manufacturing-use product with labeling that allows it to be used to make end-use products with that use pattern. Thus, for example, a subchronic oral dosing study is needed to evaluate the safety of any manufacturing-use product that legally could be used to make an end-use, food-crop pesticide. But if an end-use product's label specified it was for use only in ways that involved no food/feed exposure and no repeated human exposure, the subchronic oral dosing study would not be required to evaluate the product's safety; and if a manufacturing-use product's label states that the product is for use only in making end-use products not involving food/feed use or repeated human exposure, that subchronic oral study would not be relevant to the evaluation of the manufacturing-use product either.

If a registrant of a currently registered manufacturing-use or end-use product wishes to avoid the costs of data compensation [under FIFRA Section 3(c)(1)(D)] or data generation [under Section 3(c)(2)(B)] for "generic" data that is required only with respect to some use patterns, he may elect to delete those use patterns from his labeling at the time he re-registers his product. An applicant for registration of a new product under this Standard may similarly by request approval for only certain use patterns.

Data Compensation Requirements under FIFRA 3(c)(1)(D)

Under FIFRA Section 3(c) (1) (D), an applicant for registration, re-registration, or amended registration must offer to pay compensation for certain existing data the Agency has used in developing the Registration Standard. The data for which compensation must be offered is all data which is described by all the following criteria:

(1) the data were first submitted to EPA (or to its predecessor agencies, USDA or FDA), on or after January 1, 1970;
(2) the data were submitted to EPA (or USDA or FDA) by some other applicant or registant in support of an application for an experimental use permit, an amendment adding a new use to a registration, or for registration, or to support or maintain in effect an existing registration.
(3) they are the kind of data which are relevant to the Agency's decision to register or re-register the applicant's product under the Registration Standard, taking into account the applicant's product's composition and intended use pattern(s);
(4) the Agency has found the data to be valid and usable in reaching regulatory conclusions; and
(5) they are not data for which the applicant has been exempted by FIFRA Section 3(c)(2)(D) from the duty to offer to pay compensation. (This exemption applies to the "generic" data concerning the safety of an active ingredient of the applicant's product, not to "product specific" data. The exemption is available only to applicants whose product is labeled for end-uses for which the active ingredient in question is present in the applicant's product because of his use of another registered product containing that active ingredient which he purchases from another producer.)

An applicant for re-registration of an already registered product under this Standard, or for registration of a new product under this Standard, accordingly must determine which of the data used by EPA in developing the Standard must be the subject of an offer to pay compensation, and must submit with his application the appropriate statements evidencing his compliance with FIFRA Section 3(c)(1)(D).

An applicant would never be required to offer to pay for "product specific" data submitted by another firm. In many, if not in most cases, data which is specific to another firm's product will not suffice to allow EPA to evaluate the applicant's product, that is, will not be useful to the Agency in determining whether the applicant's product is registrable. There may be cases, however, where because of close similarities between the composition of two or more products, another firm's data may suffice to allow EPA to evaluate some or all of the "product specific" aspects of the applicant's product. In such a case, the applicant may choose to cite that data instead of submitting data from tests on his own product, and if he chooses that option, he would have to comply with the offer-to-pay requirements of Section 3(C)(1)(D) for that data.

Each applicant for registration or re-registration of a manufacturing-use product, and each applicant for registration or re-registration of an end-use product, who is not exempted by FIFRA Section 3(c)(2)(D), must comply with the Section 3(c)(1)(D) requirements with respect to each item of "generic" data that relates to his product's intended uses.

A detailed description of the procedures an applicant must follow in applying for re-registration (or new registration) under this Standard is found in the Guidance Package for this Standard.

Obtaining Data to Fill "Data Gaps"; FIFRA 3(c)(2)(B)

Some of the kinds of data EPA needs for its evaluation of the properties and effects of products to which this Standard applies have never been submitted to the Agency (or, if submitted, have been found to have deficiencies rendering them inadequate for making registrability decisions) and have not been located in the published literature search that EPA conducted as part of preparing this Standard. Such instances of missing but required data are referred to in the Standard as "data gaps".

FIFRA Section 3(c)(2)(B), added to FIFRA by the Congress in 1978, authorizes EPA to require registrants to whom a data requirement applies to generate (or otherwise produce) data to fill such "gaps" and submit those data to EPA. EPA must allow a reasonably sufficient period for this to be accomplished. If a registrant fails to take appropriate and timely steps to fill the data gaps identified by a section 3(c)(2)(B) order, his product's registration may be suspended until the data is submitted. A mechanism is provided whereby two or more registrants may agree to share in the costs of producing data for which they are both responsible.

The Standard lists, in its summary second chapter, the "generic" data gaps and notes the classes of products to which these data gaps pertain. The Standard also points out that to be registrable under the Standard, a product must be supported by certain required "product specific" data. In some cases, the Agency may posses sufficient "product specific" data on one currently registered product, but may lack such data on another. Only those Standards which apply to a very small number of currently registered products will attempt to state definitively the " product specific" data gaps on a 'product by product' basis. (Although the Standard will in some cases note which data that EPA does possess would suffice to satisfy certain "product specific" data requirements for a category of products with closely similar composition characteristics.)

As part of the process of re-registering currently registered products, EPA will issue Section 3(c)(2)(B) directives requiring the registrants to take appropriate steps to fill all identified data gaps whether the data in question is "product specific" or "generic" in accordance with a schedule.

Persons who wish to obtain registrations for new products under this Standard will be required to submit (or cite) sufficient "product specific" data before their applications are approved. Upon registration, they will be required under Section 3(c)(2)(B) to take appropriate steps to submit data needed to fill "generic" data gaps. (We expect they will respond to this requirement by entering into cost-sharing agreements with other registrants who previously have been told they must furnish the data.) The Guidance Package for this Standard details the steps that must be taken by registrants to comply with Section 3(c)(2)(B).

Amendments to the Standard

Applications for registration which propose uses or formulations that are not presently covered by the Standard, or which present product compositions, product chemistry data, hazard data, toxicity levels, or labeling that do not meet the requirements of the Standard, will automatically be considered by the Agency to be requests for amendments to the Standard. In response to such applications, the Agency may request additional data to support the proposed amendment to the Standard, or may deny the application for registration on the grounds that the proposed product would cause unreasonable adverse effects to the environment. In the former case, when additional data have been satisfactorily supplied, and providing that the data do not indicate the potential for unreasonable adverse effects, the Agency will then amend the Standard to cover the new registration.

Each Registration Standard is based upon all data and information available to the Agency's reviewers on a particular date prior to the publication date. This "cut-off" date is stated at the beginning of the second chapter. Any subsequent data submissions and any approved amendments will be incorporated into the Registration Standard by means of addenda, which are available for inspection at EPA in Washington, D.C., or copies of which may be requested from the Agency. When all the present "data gaps" have been filled and the submitted data have been reviewed, the Agency will revise the Registration Standard. Thereafter, when the Agency determines that the internally maintained addenda have significantly altered the conditions for registration under the Standard, the document will be updated and re-issued for publication.

While the Registration Standard discusses only the uses and hazards of products containing the designated active ingredient(s), the Agency is also concerned with the potential hazards of some inert ingredients and impurities. Independent of the development of any one Standard, the Agency has initiated the evaluation of some inert pesticide ingredients. Where the Agency has indentified inert ingredients of concern in a specific product to which the Standard applies, these ingredients will be pointed out in the Guidance Package.

II

REGULATORY POSITION ON ETHOXYQUIN

1. Introduction

This chapter is the central part of the Registration Standard. It presents the Agency's regulatory position and rationale based on an evaluation of all registered products containing ethoxyquin as the sole active ingredient, or in mixtures with the same use patterns as described in this Standard. After describing the chemical, the review of ethoxyquin by the Food and Drug Administration, and the discussion of ethoxyquin's classification as a minor use chemical, this chapter presents the regulatory position and rationale, the criteria by which applicants for registration of ethoxyquin products will be approved, including discussion of specific labeling considerations, and tolerance reassessment. Thus, this chapter contains all of the Agency's requirements for continued registration of ethoxyquin products and new product registrations that are covered by the Standard. Discussions of the data upon which this regulatory position is based are presented in each of the disciplinary chapters, IV through VIII.

2. Description of Chemical

Ethoxyquin is the generic name for 6-ethoxy-1,2-dihydro-2,2,4-trimethylquinoline, used to control scald in apples and pears; as a food preservative (21 CFR 172.40) to inhibit color changes in select spices; as a food additive in animal feeds (21 CFR 573.380) and in select dehydrated forage crops (21 CFR 573.400). Scald is a physiological disorder of fruit which results in discoloration (browning) of the large areas of the fruit, usually rendering it unfit for the fresh market. The disorder is superficial in nature, but the cosmetic effect is a significant factor in downgrading fruit during inspection and culling.

Only the pesticidal uses of ethoxyquin will be addressed in this Standard. Ethoxyquin is also known by the following trade names: Santoquin, Santoflex AW, Niflex D, Stop-Scald, and Deccoquin.

3. Investigation by Other Federal Agencies

It is significant to note that the Food and Drug Administration (FDA) is currently evaluating ethoxyquin as a food additive under its Cyclic Review Program. Ethoxyquin is one of 258 direct food additives which are scheduled to undergo review in order to evaluate their potential hazard, if any, in human food.

The review currently has 55 color additives, 258 direct additives, and 1332 flavors which are now in Phase II, or safety profile evaluation. An "index of concern" is assigned each chemical, based on review of all toxicity data available on each substance. The evaluation of ethoxyquin and assignment of a corresponding "index of concern" is scheduled to be completed in October 1981.

A review of the FDA data files revealed no major data gaps nor any significant inconsistencies in scientific references when compared to the data base compiled by EPA.

4. Classification Under Minor Use

Low market volume chemicals (usually those with less than 250,000 lbs. active ingredient used per year) and formulated products (usually those with less than 25,000 lbs. active ingredient per year) from which exposure is expected to be minimal based on use pattern, available data, and other considerations may be classified by EPA as having minor use status.

Estimates made by EPA staff indicate that production of ethoxyquin during the most recent five year period is less than 30,000 pounds of active ingredient in all formulated products per year. These estimates are based on International Trade Commission data, Department of Commerce data and other published sources, as well as contacts with industry representatives familiar with this market.

Accordingly, ethoxyquin is classified as a minor use chemical. As a result, many data requirements, particularly in the areas of Toxicology, Ecological Effects, and Environmental Fate have been waived in this Standard. Waiving these requirements is a result of a thorough review of the uses and subsequent potential exposure to humans and wildlife, primarily through the food chain, which indicate exposure to be minimal.

5. Regulatory Position for Ethoxyquin

Ethoxyquin as described in this Standard may be registered for sale, distribution, reformulation and use in the United States. The Agency has considered the limited amount of scientific data obtained from the open literature as of Feb. 11, 1980, and the data submitted by the registrants up through the time of publication of this Standard. In view of this information, the Agency finds that none of the risk criteria found in section 162.11(a) of Title 40 of the U.S. Code of Federal Regulations have been met or exceeded by ethoxyquin, and that ethoxyquin does not appear to cause an unreasonable adverse effect with proper label directions and precautions.

Ethoxyquin products currently registered may be reregistered under this Standard subject to the conditions imposed by this Standard. New products may be registered under this Standard and are subject to the same requirements.

6. Regulatory Rationale

The Agency has reviewed the data available to it on ethoxyquin. Based on this review, the information on ethoxyquin's use patterns, methods of application, and the limited poundage active ingredient marketed per year, the Agency has concluded that ethoxyquin products currently registered may be re-registered in accordance with the criteria set forth below.

a. Manufacturing-Use Ethoxyquin

Data on physical and chemical properties and acute toxicity are required for all ethoxyquin manufacturing-use products to establish the physical and chemical properties and the acute toxicity of the active ingredient.

b. Formulated Ethoxyquin

Emulsifiable concentrate ethoxyquin and impregnated fruit wraps may be registered for use in the United States.

The registration is dependent upon filling the data gaps listed in the Tables in Chapter 3 and identified in the disciplinary chapters for EC ethoxyquin and upon meeting standards for nondomestic use.

The outdoor (spray) uses of ethoxyquin are reportedly no longer practiced, but this use still appears on the label. Lack of data on the fate of ethoxyquin in the environment and its toxicity to non-target organisms are the basis for Ecological Effects and Environmental Fate data requirements in Chapter 3. Removal of this use from the label will reduce significantly this major route of exposure. This reduction, coupled with the low probability of accidental spills, flooding, and unintentional discharge of wastes will enable waiving of these data requirements.

7. Criteria for Registration Under This Standard

To be subject to this Standard ethoxyquin products must meet the following conditions:

1. The product must meet composition standards specified in this Chapter;

2. The product must meet acute toxicity limits specified in this Chapter;

3. The product must meet the labeling standards specified in this Chapter.

In addition, applicants for registration or reregistration of ethoxyquin products subject to this Standard must comply with all terms and conditions described in this Standard including commitment to fill data gaps according to the time schedule specified by the Agency and, when applicable, offer to pay compensation to the extent required by Sections 3(c)(1)(D) and 3(c)(2)(D) of the Federal Insecticide, Fungicide and Rodenticide Act [FIFRA], as amended, 7 U.S.C. 136(c)(1)(D) and 136(c)(2)(D).

The following registrants have submitted data in support of ethoxyquin registrations, and have not waived their rights to compensation for this data: Monsanto Chemical Company, St. Louis, Missouri, and Crown-Zellerbach Corporation, San Francisco, California.

A. Manufacturing-use Ethoxyquin

1. Acceptable Ranges and Limits

a. Product Composition Standard

To be registered under this Standard, manufacturing-use ethoxyquin must comply with the product composition standards developed in the Product Chemistry chapter (Chapter IV) of this document. Therefore, manufacturing-use ethoxyquin products with any percentage of active ingredient with appropriate certification of limits are acceptable under this Standard.

b. Acute Toxicity Limits

The Agency will consider registration of manufacturing-use ethoxyquin products in the following toxicity categories:

	Toxicity Category			
	I	II	III	VI
Acute Oral Toxicity	YES	YES	YES	YES
Acute Dermal Toxicity	YES	YES	YES	YES
Acute Inhalation Toxicity	YES	YES	YES	YES
Primary Eye Irritation	YES	YES	YES	YES
Primary Dermal Irritation	YES	YES	YES	YES

c. Use Patterns

To be covered under this Standard, manufacturing-use ethoxyquin must be formulated into end-use anti-oxidants which are intended for nondomestic indoor or outdoor food uses. For purposes of this Standard, the term "non-domestic" means applications or uses other than those outlined in 40 CFR Sec. 162.3(m).

Data in this Standard that satisfy registration requirements may be cited if the applicant establishes that the proposed product is substantially similar to another product for which the Agency has received acceptable acute toxicity tests. Data may be cited provided compensation has been offered to the submitter(s) of the data as explained in Chapter I of this Standard.

2. Required Labeling

All manufacturing-use ethoxyquin products must bear appropriate labeling as specified in 40 CFR 162.10.

a. Use Pattern Statements

All manufacturing-use ethoxyquin products must list on the label the intended end-uses of formulated products produced from the manufacturing-use products. In accordance with data to be submitted or cited, all ethoxyquin product labels must bear one of the following statements:

> "For formulation into End-use products intended Only for Non-Domestic, Outdoor Food Use"; or
>
> For formulation into End-use products intended Only for Non-Domestic, Indoor Food Use", or
>
> For formulation into End-use products intended Only for Non-Domestic Indoor or Outdoor Food Use".

For purposes of this Standard, the term "Non-domestic" means applications or uses other than those outlined below [See 40 CFR 162.3(m)].

The term "domestic application" means application of a pesticide directly to humans or pets, or application of a pesticide in, on or around all structures, vehicles or areas associated with the household or home life, patient care areas of health related institutions, or areas where children spend time including but not limited to:

(1) Gardens, non-commercial greenhouses, yards, patios, houses, pleasure marine craft, mobile homes, campers and recreational vehicles, non-commercial campsites, home swimming pools and kennels;

(2) Articles, objects, devices or surfaces handled or contacted by humans or pets in all structures, vehicles or areas listed above;

(3) Patient care areas of nursing homes, mental institutions, hospitals, and convalescent homes;

(4) Educational, lounging and recreational areas of preschools, nurseries and day camps.

Presented below are the types of statements which must appear on manufacturing-use ethoxyquin labels. See 40 CFR 162.10 for specific required labeling for manufacturing-use products.

b. PRECAUTIONARY STATEMENTS

Hazards to Humans and Domestic Animals

May irritate eyes, nose, throat, and skin.
Avoid contact with skin, eyes and clothing.

First Aid Statement

In case of contact, immediately flush skin or eyes with plenty of water. Get medical attention if irritation persists. Wash thoroughly after using.

Environmental Hazards

Do not discharge into lakes, streams, ponds, or public waters unless in accordance with an NPDES permit. For guidance, contact your regional office of EPA.

Directions for Use

It is a violation of federal law to use this product in a manner inconsistent with its labeling. Refer to technical bulletin.

Storage and Disposal

Prohibitions

Do not contaminate water, food, or feed by storage or disposal.

Open dumping is prohibited.

Pesticide Disposal

Pesticide or rinsate that cannot be used according to label instructions must be disposed of according to state or local procedures under the Resources Conservation and Recovery Act.

Container Disposal

Triple rinse (or equivalent) and offer for recycling or reconditioning or dispose of in a sanitary landfill or by approved state and local procedures.

B. Emulsifiable Concentrate Ethoxyquin

Applicants for registration or reregistration of formulated ethoxyquin products are reminded that since no manufacturing-use product (MUP) is currently registered, formulators of end-use products are responsible for providing the data required on the manufacturing-use product in order to comply with the Agency's Proposed Registration Standards Data Requirements as outlined in Chapter 3.

1. Acceptable Ranges and Limits

a. Product Composition Standard

The Agency will consider for registration emulsifiable concentrate products which contain ethoxyquin as the sole active ingredient if the products meet the acute toxicity standards for nondomestic use, and if the inert ingredients have been cleared under 40 CFR 180.1001. The Product Chemistry, Residue Chemistry and Toxicology data must be supplied by the formulators of end-use ethoxyquin products.

b. Acute Toxicity Limits

The Agency will consider registration of any emulsifiable concentrate (EC) product for non-domestic use in the following categories:

	TOXICITY CATEGORY			
	I	II	III	IV
Acute Oral Toxicity	amendment required*	YES	YES	YES
Acute Dermal Toxicity	amendment required*	YES	YES	YES
Acute Inhalation Toxicity	amendment required*	YES	YES	YES
Primary Eye Irritation	amendment required*	YES	YES	YES
Primary Dermal Irritation	amendment required*	YES	YES	YES

*(Amendment to the Standard)

c. Use Patterns and Application Methods

To be registered under this Standard, EC products of ethoxyquin may be used only as anti-oxidants on apples and pears.

The Agency finds that currently registered dosage rates and application methods are acceptable pending submission of required chemistry data listed in the manufacturing use section of this Standard .

2. Required Labeling

All EC ethoxyquin products must bear appropriate labeling as specified in 40 CFR 162.10.

a. PRECAUTIONARY STATEMENTS

Hazards to Humans and Domestic Animals

May irritate eyes, nose, throat, and skin. Avoid breathing vapors. Avoid contact with skin, eyes and clothing.

First Aid Statement

In case of contact, flush skin or eyes with plenty of water. Get medical attention if irritation persists. Wash thoroughly after using.

Environmental Hazards

Do not apply directly to lakes, streams and ponds. Do not contaminate water by cleaning of equipment or disposal of wastes.

Directions for Use

It is a violation of federal law to use this product in a manner inconsistent with its labeling.

Currently Registered Application Rates

APPLES	PEARS
1.50-2.25 lbs. a.i./ 100 gal. water Postharvest Dip or Spray (70% EC)	1.50-2.25 lbs. a.i./ 100 gal. water 70% EC
1 part product/ 200 parts water (2,700ppm) 52.2% EC	1 part product/200 parts water (2,700ppm) 52.2% EC
1.00 gal. product/ 250 gal. water (2,700ppm) 59% EC	1.00 gal product/250 gal water (2,700ppm) 59% EC
2.25 lbs. a.i./100 gal. water (65.5% EC)	

b. GENERAL INFORMATION

Post-harvest applications to fruit (dip or spray) should include thorough draining of fruit before placement in cold storage. Treatment should not exceed 2 or 3 minutes. Preharvest spray to trees should be applied within 2 days of harvest. Application to trees should not be made if daily maximum temperature exceeds 85 degrees F. (29.4 C). Wet or drench all fruit.

Storage and Disposal

Prohibitions

Do not contaminate water, food, or feed by storage or disposal. Open dumping is prohibited.

Pesticide Disposal

Pesticide or rinstate that cannot be used according to label instructions must be disposed of according to state or local procedures or disposed of under the Resources Conservation and Recovery Act.

Container Disposal

Triple rinse (or equivalent) and offer for recycling or reconditionning, or dispose of in a sanitary landfill or by approved state or local procedures.

General

Consult federal, state or local disposal authorities for approved alternative procedures.

C. Impregnated Fruit Wraps

1. •Acceptable Ranges and Limits

a. Product Composition Standards

To be covered under this Standard, fruit wraps impregnated with ethoxyquin with any percentage of ingredients are acceptable, provided residues no greater than 3 ppm. remain on fruit at time of market as a result of their use.

Inert ingredients must be cleared under 40 CFR 180.1001.

b. Acute Toxicity Limits

The Agency will consider registration of fruit wraps impregnated with ethoxyquin in the following categories:

	TOXICITY CATEGORY			
	I	II	III	IV
Acute Oral Toxicity	amendment required*	YES	YES	YES
Acute Dermal Toxicity	amendment required*	YES	YES	YES
Acute Eye Irritation	amendment required*	YES	YES	YES
Acute Dermal Irritation	amendment required*	YES	YES	YES

*(Amendment to the Standard)

c. Use Patterns and Application Methods

To be registered under this Standard, products impregnated with ethoxyquin may be used only as anti-oxidants on apples and pears. The Agency finds that current formulation rates and application methods are acceptable under this Standard.

2. Required Labeling

All impregnated ethoxyquin products must bear appropriate labeling as specified in 40 CFR 162.10.

Presented below are types of statements which must appear on impregnated ethoxyquin labels. See 40 CFR 162.10 for specific required labeling for formulated products.

a. PRECAUTIONARY STATEMENTS

Hazards to Humans and Domestic Animals

May irritate eyes, nose, and throat.

Storage and Disposal

Do not re-use fruit wrap. Dispose of in trash collection.

Directions for Use

It is a violation of federal law to use this product in a manner inconsistent with its labeling.

Currently Registered Application Rates

Formulation	Site	Application-Type/Rate
0.04% a.i. 0.131% a.i.	Apples	Postharvest wrap. Wrap fruit within 1 wk. of harvest.
0.04% a.i.	Pears	(Same as above)

b. General Warnings and Limitations:

Do not use impregnated wraps on fruit which has been previously treated with ethoxyquin preharvest or postharvest.
Prolonged exposure of chemical to air or sunlight may result in darkening of the product and staining of the fruit.

8. Tolerance Reassessment

Tolerances have been established for residues of ethoxyquin in or on raw agricultural commodities as indicated: 3 ppm in or on apples and pears (FDA; 40 CFR 180.178).

Ethoxyquin at 150 ppm or less is added directly to animal feeds (21 CFR 573.380) and dehydrated forages (21 CFR 573.400), and tolerances for residues of ethoxyquin in eggs, meat and meat by-products have been established to provide for such feed additive use (21 CFR 172.140). Residues from apple and pear waste are unlikely to contribute a significant increment of ethoxyquin to the diet of food-producing animals. In addition pears and apples treated post harvest with ethoxyquin are destined for the fresh market, and little or no processed waste is expected.

The Theoretical Maximum Residue Contribution (TMRC) of ethoxyquin to the human diet from pesticidal uses is calculated to be 0.12 mg/kg/1.5 kg.diet. This estimate is based on average adult eating patterns and on the assumption that each commodity contains residues which meet the established tolerance level. The TMRC is based on the above indicated crop tolerances, which can no longer be supported with the inadequate data at hand. There are, however, no data to suggest that maximum dosage rates on currently registered labels would produce residues that would exceed these existing tolerances.

In addition, international (CODEX) tolerances of 3 ppm have been recommended for residues of ethoxyquin in or on apples and pears. The U.S. has accepted these maximum residue limits (MRL), which are the same as the U.S. tolerances.

Accordingly, a tolerance reassessment is not possible at this time and will instead be performed when the necessary residue data for apples and pears are supplied and reviewed.

III

DATA REQUIREMENTS AND DATA GAPS

1. Manufacturing Use Ethoxyquin

Applicants for registration of manufacturing-use ethoxyquin products intended to be formulated into acceptable end-uses must cite or submit the information identified in the data tables on the physical and chemical properties, composition, fate and toxicity of the proposed product. The Agency will consider both active and inert ingredients in the determination of substantially similar products. Before each requirement is listed the Section of the Proposed Guidelines which describes the type of data and when it is required (43 FR, No. 132, 29696 of July 10, 1978; and 43 FR, No. 163, 37336 of August 22, 1978). Applicants for the registration of manufacturing-use ethoxyquin must submit information identified as data gaps.

2. Formulated Ethoxyquin Products

Applicants for registration of EC ethoxyquin products must cite or submit the information listed in the data tables on the product chemistry and acute toxicity of the proposed product. In the event that an applicant establishes that a product is substantially similar to another product for which the Agency has received acceptable acute toxicity tests, this data may be cited provided compensation has been offered to the submitters of these studies. The Agency will consider both active and inert ingredients in making the determination of substantially similar products.

Applicants for reregistration of impregnated wraps must cite or submit information on the product chemistry of the formulation used to impregnate the wrap.

Applicants are hereby advised that if the Agency does not receive commitments within the time frames specified in the data tables from manufacturing-use ethoxyquin producers to fill data gaps identified for the manufacturing-use material, the formulators must then bear the burden of supplying the data that would be required to support the reregistration of their product.

TABLE A

GENERIC DATA REQUIREMENTS AND DATA GAPS FOR MANUFACTURING-USE ETHOXYQUIN

Guideline Citation	Name of Test	Are Data Required?	Test Substance	Does EPA Have Data to Partially or Totally Satisfy Requirement?	Bibliographic Citation	Must Additional Data be Submitted under FIFRA 3(c)(2)(B)? If so, months allowed for submission.
ENVIRONMENTAL FATE						
163.63-7(b)	Hydrolysis	Yes	Tech. Grade*	No		Yes**
163.62-8(g)	Activated Sludge Metabolism	Yes	Tech. Grade	No		No**
TOXICOLOGY						
163.81-1	Acute Oral Toxicity	Yes	Tech. Grade*	No		Yes: 6 months (Sept. 30, 1981)
163.81-2	Acute Dermal Toxicity	Yes	Tech. Grade	No		Yes: 6 months (Sept. 30, 1981)
163.81-3	Acute Inhalation Toxicity	Yes	Tech. Grade*	Yes	Scientific Associates 1960 (MRID #00002202)	No
163.81-4	Primary Eye Irritation	Yes	Tech. Grade*	No		Yes: 6 months (Sept. 30, 1981)
163.81-5	Primary Dermal Irritation	Yes	Tech. Grade*	No		Yes: 6 months (Sept. 30, 1981)
163-81-6	Skin Sensitization	Yes	Tech. Grade*	Yes	Draize, Woodward and Calvery (MRID #0500474)	No

* Technical Grade of the Active Ingredient

** If the outdoor spray use is dropped from existing labels, the major route of exposure to non-target organisms will be substantially reduced. This reduction, along with the low volume use of ethoxyquin on apples and pears, minimal expected exposure, and acceptance of the international CODEX tolerances will justify waiving the data requirements for Hydrolysis. Activated Sludge requirements are being reserved pending review nad modification of the testing protocols.

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TABLE A (cont.)

GENERIC DATA REQUIREMENTS AND DATA GAPS FOR MANUFACTURING-USE ETHOXYQUIN

Guideline Citation	Name of Test	Are Data Required?	Test Substance	Does EPA Have Data to Partially or Totally Satisfy Requirement?	Bibliographic Citation	Must Additional Data be Submitted under FIFRA 3(c)(2)(B)? If so, months allowed for submission.
163.82-1	Subchronic Oral Toxicity	Yes	Tech. Grade	Yes	(See Chapter VI)	No
163.82-2	Subchronic (21-day) Dermal Toxicity	Yes	Tech. Grade	Yes	(See Chapter VI)	No
163.83-1	Chronic Feeding	Yes	Tech. Grade	Yes	U.S. Agricultural Research Service, Western Utilization Research Branch (MRID #0001923) Wilson and De Eds (MRID #05000474) Fanner and Packer (MRID #05000529) Rudra, Dickerson and Walker (MRID #05000419) Hanzal (MRID #00001925) Colorado A&M Uni. (MRID #00001919) Gassner, Buse, Hopwood and Thompson (MRID #05000517) Pascal (review article) (MRID #05000412)	No***

*** Although data are not available to reassess tolerances, a new study is not being required at this time because of the low volume use of ethoxyquin on apples and pears, minimal expected exposure, and acceptance of the international CODEX tolerances.

TABLE A (cont.)

GENERIC DATA REQUIREMENTS AND DATA GAPS
FOR MANUFACTURING-USE ETHOXYQUIN

Guideline Citation	Name of Test	Are Data Required?	Test Substance	Does EPA Have Data to Partially or Totally Satisfy Requirement?	Bibliographic Citation	Must Additional Data be Submitted under FIFRA 3(c)(2)(B)? If so, months allowed for submission.
163.83-2	Oncogenicity	Yes	Tech. Grade	Yes	Wilson and De Eds (MRID #05000474)	No
163.83-3	Teratogenicity	Yes	Tech. Grade	Yes	Telford, I.R. et al. (MRID #05000428) Wilson, R.H. (MRID #00001933) Isenstein, R.S. (MRID #05000366)	No
163.83-4	Reproduction	Yes	Tech. Grade	Yes	Monsanto Company (MRID #00001919) Monsanto Company (MRID #00001920) Wilson, R.H. (MRID #00001933) Wilson, R.H. (MRID #00001934) Wisconsin Alumni Ass'n. (MRID #00001924) Amer. Jour. of Anatomy (MRID #05000428) Amer. Jour. of Vet. Res. (MRID #05000366) Journal of Food and Ag. Chemistry (MRID #05000474)	No

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TABLE A (cont.)

GENERIC DATA REQUIREMENTS AND DATA GAPS
FOR MANUFACTURING-USE ETHOXYQUIN

Guideline Citation	Name of Test	Are Data Required?	Test Substance	Does EPA Have Data to Partially or Totally Satisfy Requirement?	Bibliographic Citation	Must Additional Data be Submitted under FIFRA 3(c)(2)(B)? If so, months allowed for submission.
163.84-1-4	Mutagenicity	Yes	Tech. Grade	Yes	Joner, P.E. (MRID #05000385)	No
163.85-1	Metabolism	Yes	Tech. Grade	Yes	Wilson, 1959 (MRID #05000475) Monsanto (MRID #00001935) TerMeulin and Walker (MRID #05002491) Skaare, J.V. and Matstad, I. (MRID #05012506)	No
PRODUCT CHEMISTRY						
163.61-8(1)	Color	Yes	Tech. Grade*	Yes	Monsanto Chem. Co. (MRID #004X) Bexolin Chem. Co. (MRID #006X)	No
163.61-8(2)	Odor	Yes	Tech. Grade	No		Yes: 6 months (Sept. 30, 1981)
163.61-8(4)	Solubility	Yes	Tech. Grade	No		Yes: 6 months (Sept. 30, 1981)
163.61-8(5)	Stability	Yes	Tech. Grade	No		Yes: 6 months (Sept. 30, 1981)
163.61-8(6)	Octanol/Water Partition Coefficient	Yes	Tech. Grade	No		Yes: 6 months (Sept. 30, 1981)
163.61-8(7)	Physical State	Yes	Tech. Grade	Yes	Monsanto Chem. Co. (MRID #004X) Bexolin Chem. Co. (MRID #006X)	No

* Technical Grade of the Active Ingredient

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TABLE A (cont.)

GENERIC DATA REQUIREMENTS AND DATA GAPS
FOR MANUFACTURING-USE ETHOXYQUIN

Guideline Citation	Name of Test	Are Data Required?	Test Substance	Does EPA Have Data to Partially or Totally Satisfy Requirement?	Bibliographic Citation	Must Additional Data be Submitted under FIFRA 3(c)(2)(B)? If so, months allowed for submission.
RESIDUE CHEMISTRY						
N.A.**	Degradation Pathway	Yes	Tech. Grade	No		Yes: 12 months (March 31, 1981)
N.A.	Residues on Apples and Pears from MAXIMUM registered uses	Yes	Tech. Grade	No		Yes: 12 months (March 31, 1981)
ECOLOGICAL EFFECTS						
163.71-1	Avian Single Dose Oral LD50	Yes	Tech. Grade*	No		Yes**
163.71-2	Avian Dietary LC50	Yes	Tech. Grade*	No		Yes**
163.72-1	Fish Acute LC50	Yes	Tech. Grade*	No		Yes**
163.72-2	Acute Toxicity to Aquatic Invertebrates	Yes	Tech. Grade*	No		Yes**

* Technical Grade of the Active Ingredient
** Data Requirements are waived because of low market volume, use patterns and application methods for ethoxyquin.
** N.A. - Not applicable.

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TABLE B

PRODUCT-SPECIFIC DATA REQUIREMENTS AND DATA GAPS FOR MANUFACTURING-USE ETHOXYQUIN PRODUCTS

Guideline Citation	Name of Test	Are Data Required?	Test Substance	Does EPA Have Data to Partially or Totally Satisfy Requirement?	Bibliographic Citation	Must Additional Data be Submitted under FIFRA 3(c)(2)(B)? If so, months allowed for submission.
PRODUCT CHEMISTRY						
163.61-3	Prod. Identity and Disclosure of Ingredients	Yes	Each MUP*	No		Yes: 6 months (Sept. 30, 1981)
163.61-4	Description of Manufacturing Process	Yes	Each MUP*	No		Yes: 6 months (Sept. 30, 1981)
163.61-5	Disc. of Format of Unint. Ingredients	Yes	Each MUP*	No		Yes: 6 months (Sept. 30, 1981)
163.61-6	Declaration of Ingredient Limits	Yes	Each MUP*	No		Yes: 6 months (Sept. 30, 1981)
163.61-7	Product Analyt. Methods and Data	Yes	Each MUP*	No		Yes: 6 months (Sept. 30, 1981)
163.61-8(7)	Physical State	Yes	MUP**	No		Yes: 6 months (Sept. 30, 1981)
163.61-8(8)	Density or Specific Gravity	Yes	MUP**	No		Yes: 6 months (Sept. 30, 1981)
163.61-8(11)	pH	Yes	MUP**	No		Yes: 6 months (Sept. 30, 1981)
163.61-8(12)	Storage Stab.	Yes	MUP***	No		Yes: 6 months (Sept. 30, 1981)

* Each Manufacturing-use Product.

** Required for Manufacturing-use Products which are not the same as the Technical Grade for the Active Ingredient. Product Chemistry data requested in TABLE-A will suffice for Manufacturing-use Ethoxyquin because it is equivalent to Technical Grade Ethoxyquin.

*** Each manufacturing-use Product or Substantially Similar Product.

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TABLE B (cont.)

PRODUCT-SPECIFIC DATA REQUIREMENTS AND DATA GAPS FOR MANUFACTURING-USE ETHOXYQUIN PRODUCTS

Guideline Citation	Name of Test	Are Data Required?	Test Substance	Does EPA Have Data to Partially or Totally Satisfy Requirement?	Bibliographic Citation	Must Additional Data be Submitted under FIFRA 3(c)(2)(B)? If so, months allowed for submission.
TOXICOLOGY						
163.81-1	Acute Oral Toxicity	Yes	MUP*	No		Yes: 6 months (Sept. 30, 1981)
163.81-2	Acute Dermal Toxicity	Yes	MUP*	No		Yes: 6 months (Sept. 30, 1981)
163.81-3	Acute Inhal.	Yes	MUP**	Yes	Scientific Associates, 1960 (MRID #00002202)	No
163.81-4	Prim. Eye Irritation***	Yes	MUP**	No		Yes: 6 months (Sept. 30, 1981)
163.81-5	Primary Dermal Irritation	Yes	MUP**	No		Yes: 6 months (Sept. 30, 1981)
163.81-6	Dermal Sensitization	Yes	MUP**	Yes	Draize, Woodward and Calvery (MRID #05000474)	No

* Required for Manufacturing-use Products which are not the same as the Technical Grade of the Active Ingredient. Acute Oral and Dermal Toxicity data requested in TABLE-A will provide needed data for Manufacturing-use Ethoxyqin because the MUP is equivalent to Technical Grade Ethoxyquin.

** Each Manufacturing-use Product or Substantially Similar Product.

*** A demonstration of pH between 1 and 3, or 12 and 14 or a demonstration of dermal irritability will be sufficient to categorize a product as an ocular irritant, and additional testing will not be required.

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TABLE C

PRODUCT-SPECIFIC DATA REQUIREMENTS AND DATA GAPS FOR EMULSIFIABLE CONCENTRATE ETHOXYQUIN PRODUCTS

Guideline Citation	Name of Test	Are Data Required?	Test Substance	Does EPA Have Data to Partially or Totally Satisfy Requirement?	Bibliographic Citation	Must Additional Data be Submitted under FIFRA 3(c)(2)(B)? If so, months allowed for submission.
PRODUCT CHEMISTRY						
163.61-3	Prod. Identity and Disclosure of Ingredients	Yes	Each E.C. Product*	No		Yes: 6 months (Sept. 30, 1981)
163.61-4	Description of Manufacturing Process	Yes	Each E.C. Product*	No		Yes: 6 months (Sept. 30, 1981)
163.61-5	Disc. of Format of Unint. Ingredients	Yes	Each E.C. Product*	No		Yes: 6 months (Sept. 30, 1981)
163.61-6	Declaration of Ingredient Limits	Yes	Each E.C. Prodcut*	No		Yes: 6 months (Sept. 30, 1981)
163.61-7	Product Analyt. Methods and Data	Yes	Each E.C. Product*	No		Yes: 6 months (Sept. 30, 1981)
163.61-8(1)	Color	Yes	Each E.C. Product*	No		Yes: 6 months (Sept. 30, 1981)
163.61-8(2)	Odor	Yes	Each E.C. Product*	No		Yes: 6 months (Sept. 30, 1981)
163.61-8(7)	Physical State	Yes	Each E.C. Product*	No		Yes: 6 months (Sept. 30, 1981)
163.61-8(8)	Density or Specific Gravity	Yes	EC**	No		Yes: 6 months (Sept. 30, 1981)
163.61-8(11)	pH	Yes	EC**	No		Yes: 6 months (Sept. 30, 1981)
163.61-8(12)	Storage Stab.	Yes	EC**	No		Yes: 6 months (Sept. 30, 1981)

* Each Emulsifiable Concentrate Product.

** Each Emulsifiable Concentrate Product or Substantially Similar Product

TABLE C (cont.)

PRODUCT-SPECIFIC DATA REQUIREMENTS AND DATA GAPS
FOR EMULSIFIABLE CONCENTRATE ETHOXYQUIN PRODUCTS

Guideline Citation	Name of Test	Are Data Required?	Test Substance	Does EPA Have Data to Partially or Totally Satisfy Requirement?	Bibliographic Citation	Must Additional Data be Submitted under FIFRA 3(c)(2)(B)? If so, months allowed for submission.
TOXICOLOGY						
163.81-1	Acute Oral Toxicity	Yes	EC*	Yes	Younger, 1960 (MRID #00001880)	No
163.81-2	Acute Dermal Toxicity	Yes	EC	Yes	Younger, 1960 (MRID #00001884)	No
163.81-3	Acute Inhal. Toxicity	Yes	EC	Yes	Scientific Associates, 1960 (MRID #GS-0003-4)	No
163.81-4	Prim. Eye Irritation**	Yes	EC	Yes	Younger, 1960 (MRID #00001884)	No
163.81-5	Primary Dermal Irritation	Yes	EC	Yes	Younger, 1960 (MRID #00001884)	No
163.81-6	Dermal Sensitization	Yes	EC	Yes	See Supplementary Information Topics (Chapter VI)	No

* Each Emulsifiable Concentrate Product or Substantially Similar Product.

** A demonstration of pH between 1 and 3, or 12 and 14 or a demonstration of dermal irritability will be sufficient to categorize a product as an ocular irritant, and additional testing will not be required.

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TABLE D

PRODUCT-SPECIFIC DATA REQUIREMENTS AND DATA GAPS FOR IMPREGNATED ETHOXYQUIN PRODUCTS

Guideline Citation	Name of Test	Are Data Required?	Test Substance	Does EPA Have Data to Partially or Totally Satisfy Requirement?	Bibliographic Citation	Must Additional Data be Submitted under FIFRA 3(c)(2)(B)? If so, months allowed for submission.
PRODUCT CHEMISTRY						
163.61-3	Prod. Identity and Disclosure of Ingredients	Yes	Each IMP Product*	No		Yes: 6 months (Sept. 30, 1981)
163.61-4	Description of Manufacturing Process	Yes	Each IMP Product*	No		Yes: 6 months (Sept. 30, 1981)
163.61-5	Disc. of Format of Unint. Ingredients	Yes	Each IMP Product*	No		Yes: 6 months (Sept. 30, 1981)
163.61-6	Declaration of Ingredient Limits	Yes	Each IMP Product*	No		Yes: 6 months (Sept. 30, 1981)
163.61-7	Product Analyt. Methods and Data	Yes	Each IMP Product*	No		Yes: 6 months (Sept. 30, 1981)
163.61-8(1)	Color	Yes	Each IMP Product*	No		Yes: 6 months (Sept. 30, 1981)
163.61-8(2)	Odor	Yes	Each IMP Product*	No		Yes: 6 months (Sept. 30, 1981)
163.61-8(7)	Physical State	Yes	Each IMP Product*	No		Yes: 6 months (Sept. 30, 1981)
163.61-8(8)	Density or Specific Gravity	Yes	IMP**	No		Yes: 6 months (Sept. 30, 1981
163.61-8(9)	Boiling Point	Yes	IMP**	No		Yes: 6 months (Sept. 30, 1981)
163.61-8(10)	Vapor Pressure	Yes	IMP**	No		Yes: 6 months (Sept. 30, 1981)
163.61-8(11)	pH	Yes	IMP**	No		Yes: 6 months (Sept. 30, 1981)
163.61-8(12)	Storage Stab.	Yes	IMP**	No		Yes: 6 months (Sept. 30, 1981)

NOTE: If registrants can demonstrate that the material used to impregnate wraps is substantially similar to the technical or manufacture-use formulations, the toxicology data requirements for the impregnated wraps will be waived.

* Each Impregnated Product.
** Each Impregnated Product or Substantially Similar Product

TABLE D (cont.)

PRODUCT-SPECIFIC DATA REQUIREMENTS AND DATA GAPS
FOR IMPREGNATED ETHOXYQUIN PRODUCTS

Guideline Citation	Name of Test	Are Data Required?	Test Substance	Does EPA Have Data to Partially or Totally Satisfy Requirement?	Bibliographic Citation	Must Additional Data be Submitted under FIFRA 3(c)(2)(B)? If so, months allowed for submission.
TOXICOLOGY						
163.81-1	Acute Oral Toxicity	Yes	IMP*	No		Yes: 6 months (Sept. 30, 1981)
163.81-2	Acute Dermal Toxicity	Yes	IMP	No		Yes: 6 months (Sept. 30, 1981)
163.81-3	Acute Inhal. Toxicity	Yes	IMP	No		Yes: 6 months (Sept. 30, 1981)
163.81-4	Prim. Eye Irritation**	Yes	IMP	No		Yes: 6 months (Sept. 30, 1981)
163.81-5	Primary Dermal Irritation	Yes	IMP	No		Yes: 6 months (Sept. 30, 1981)
163.81-6	Dermal Sensitization	Yes	IMP	No		Yes: 6 months (Sept. 30, 1981)

NOTE: If registrants can demonstrate that the material used to impregnate wraps is substantially similar to the technical or manufacture-use formulations, the toxicology data requirements for the impregnated wraps will be waived.

* Each Impregnated Product or Substantially Similar Product.

** A demonstration of pH between 1 and 3, or 12 and 14 or a demonstration of dermal irritability will be sufficient to categorize a product as an ocular irritant, and additional testing will not be required.

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IV

PRODUCT CHEMISTRY

A. Introduction

FIFRA 3(c)(2)(A) requires the Agency to establish guidelines for registering pesticides in the United States. The Agency requires registrants to provide quantitative data on all added ingredients, active and inert, which are equal to or greater than 0.1% of the product by weight. A review of the "confidential statement of formula for the end-use products of Ethoxyquin indicates that all inert ingredients are cleared under CFR 40 Part I Sec. 180.1001.

To establish the composition of products proposed for registration, the Agency requires data and information not only on the manufacturing and formulation processes but also a discussion on the formation of manufacturing impurities and other product ingredients, intentional and unintentional. Further, to assure that the composition of the product as marketed will not vary from the composition evaluated at the time of registration, applicants are required to submit a statement certifying upper and lower composition limits for the added ingredients, or upper limits only for some unintentional ingredients. Subpart D of the Proposed Guidelines (43 FR 29696, July 10, 1978) suggests specific precision limits for ingredients based on the percentage of ingredient and the degree of accuracy of the analytical method.

In addition to the data on product composition, the Agency guidelines also require data to establish the physical and chemical properties of both the pesticide active ingredient and its formulations. For example, data are needed concerning the identity and physical state of the active ingredient (e.g., melting and boiling point data, ambient vapor pressure and solubility). Data are also required on the properties of the formulated product to establish labeling cautions (e.g., flammability, corrosiveness or storage stability). The Agency uses these data to characterize each pesticide and to determine its environmental and health hazards.

B. Product Chemistry - Manufacturing-Use Ethoxyquin

1. Product Chemistry Profile

No manufacturing use products containing ethoxyquin are currently registered. Applicants for registration of ethoxquin products are reminded that since no manufacturing use products are currently registered, the formulators are responsible for supplying the required data for the manufacturing-use chemical as outlined in Chapter 3.

Because it is considered "Confidential Business Information", a discussion of the specific procedures, equipment, and manufacturing conditions required for the commercial production of the chemical will not be included in this standard.

The Farm Chemicals Handbook 1980 shows Monsanto Company, the only basic U.S. producer of Ethoxyquin, as having discontinued production of the 70% Emulsifiable Concentrate formulation. Contact with industry also indicates that, along with the discontinuance of the pre-harvest spray use, most of the other uses of ethoxyquin with the exception of the impregnated wraps have been abandoned.

A small amount of data are available on the physical and chemical properties of technical ethoxyquin. See Data Tables in Chapter 3.

2. Data Requirements

Refer to Chapter 3 for Product Chemistry data needed to support the registration of any manufacturing-use ethoxyquin product. Following each data requirement is the section in the Proposed Guidelines for the Registration of Pesticides in the United States (43 FR 29696, July 10, 1978) that describes the type of data required. The applicant for registration must submit or cite this information.

3. Topical Discussions

Corresponding to each of the Topical Discussions listed below is the number of the section in the 'Proposed Guidelines for Registering Pesticides' in the United States (43 FR 29696, July 10, 1978) which explains the minimum data that the Agency requires in order to adequately assess Product Chemistry of manufacturing-use ethoxyquin products. Also under each of the following topics is a reference to the appropriate section in the 'Proposed Guidelines'.

	Guidelines Section
Chemical Identity	163.61-3
Manufacturing Processes	163.61-4
Formation of Unintentional Ingredients	163.61-5
Active Ingredient Limits in Pesticide Products	163.61-6
Product Analytical Methods and Data	163.61-7
Physical/Chemical Properties	163.61-8

Chemical Identity [163.61-3(c)]

The Proposed Guidelines require identifying information including chemical names, product names, and numerical codes of all substances known or assumed to be present in pesticide products. See tables in Chapter 3.

"Ethoxyquin" is the generic name for 6-ethoxy-1,2-dihydro-2,2,4-trimethyl-quinoline. Ethoxyquin is a derivative of quinoline. Trade names for Ethoxyquin are: Santoquin, Santoflex AW, Niflex D, Stop-scald, and Deccoquin. The name "Ethoxyquin" will be routinely used in this standard in lieu of other chemical or trade names.

Manufacturing Processes [163.61-4(b)]

Because the route by which a pesticide is synthesized determines the nature and amount of potentially toxic impurities, a detailed description of the manufacturing process is required.

Formation of Unintentional Ingredients [163.61-5]

Section 163.61-5 of the Proposed Guidelines requires registrants of manufacturing-use and of formulated products to submit a theoretical discussion of the formation of unintended substances in the product.

A theoretical discussion of the formation of unintended substances has not been submitted for manufacturing-use ethoxyquin. Such a discussion is required for each manufacturing-use product.

Active Ingredient Limits in Pesticide Products [163.61-6]

The Guidelines require that upper and lower limits be established for each active ingredient and each intentionally added inert in a pesticide product. Technical ethoxyquin contains approximately 95% of the pure chemical.

Upper and lower limits have not been established and certified for technical ethoxyquin.

Product Analytical Methods and Data [163.61-7]

The Guidelines require submission of, or reference to, analytical methods for measuring each active ingredient in a pesticide product.

Section 163.61-7 of the Proposed Guidelines also require that applications for registration of pesticide products contain analytical data obtained by methods supplied to the Agency.

Adequate analytical methods for the identification and quantification of Ethoxyquin in the technical and formulated end-use product have not been submitted. Acceptable methods for the analysis of impurities also have not been submitted. The manufacturer, i.e., Monsanto, did not report I.R. or U.V. spectra which could be used in the identification of Ethoxyquin.

Physical and Chemical Properties [163.61-8]

For every pesticide product, the Proposed Guidelines require data on certain physical and chemical properties useful for identification purposes or for evaluation of hazard potential.

A small amount of data are available on the physical and chemical properties of ethoxyquin. Available data on purified ethoxyquin (Monsanto, 1975, MRID #004X; Rexolin Chemicals, 1971, MRID #006X) give these details:

Color: Varies from yellow to brown. Darkens when exposed to light or air.
Boiling Point: 125°C at 2 mm Hg.
Density or Specific Gravity: 1.03 at 25°C
Physical State: Technical ethoxyquin is a liquid when purified.
Flammability: Flash point 285-290°F (COC) and >175°F (TCC)

C. Product Chemistry - Emulsifiable Concentrate Ethoxyquin

See the Tables in Chapter 3 for a complete listing of the Data Requirements and Data Gaps for EC ethoxyquin.

1. Topical Discussions

The product chemistry of ethoxyquin has been dealt with in the Manufacturing-Use Ethoxyquin section of this chapter. The following are data required of all EC formulated products of ethoxyquin.

Active Ingredient Limits in Pesticide Products [163.61-5]

For all pesticide products, the Guidelines would require that upper and lower limits be established for each active ingredient, impurity, reaction product, and degradation product.

Current registrations of EC ethoxyquin contain 52.2, 59.0, 65.5, and 70% active ingredient.

Product Analytical Methods and Data [163.61-7]

The Guidelines would require submission of, or reference to, analytical methods measuring each active ingredient in a pesticide product.

Section 163.61-7 of the Proposed Guidelines would require that applications for registration of pesticide products contain analytical data obtained by methods supplied to the Agency. Data obtained by the method described above have not been submitted.

Section 163.61-7 of the Proposed Guidelines would also require that registrants of formulated products produced by an integrated formulation system (Proposed Guidelines, section 163.61-1) submit methods not only for the active ingredient, but for each identifiable impurity associated with manufacture of the technical chemical. Such methods have not been submitted for any ethoxyquin formulation.

Physical and Chemical Properties [163.61-8]

For every pesticide product, the Proposed Guidelines would require data on certain physical and chemical properties useful for identification purposes or for evaluation of hazard potential.

The following physical and chemical properties are required for all EC products of ethoxyquin. No data have been submitted.

Required Physical/Chemical Properties: Color, odor, density or specific gravity, pH, storage stability, flammability, oxidizing or reducing action, explosiveness, and corrosion characteristics.

D. Product Chemistry - Impregnated Product Ethoxyquin

See Tables in Chapter 3 for the Data Requirements and Data Gaps corresponding to the impregnated formulation.

1. Topical Discussions

Registrants are advised that if some formulation other than the technical or manufacturing-use product is used in the manufacture of impregnated wraps, the aforementioned data requirements must be fulfilled for that formulation.

The product chemistry of ethoxyquin *per se* has been dealt with in the Manufacturing-use Ethoxyquin section of this chapter. The following are data required of all impregnated formulated products of ethoxyquin.

Active Ingredient Limits in Pesticide Products [163.61-5]

For all pesticide products, the Guidelines would require that upper and lower limits be established for each active ingredient, impurity, reaction product, and degradation product.

Current federal registrations of impregnated ethoxyquin products contain 0.04 to 0.131% a.i.

An upper and lower limit for wraps impregnated with ethoxyquin has not been established.

Product Analytical Methods and Data [163.61-7]

The Guidelines would require submission of, or reference to, analytical methods measuring each active ingredient in a pesticide product.

Section 163.61-7 of the Proposed Guidelines would require that applications for registration of pesticide products contain analytical data obtained by methods supplied to the Agency.

Section 163.61-7 of the Proposed Guidelines would also require that registrants of formulated products produced by an integrated formulation system (Proposed Guidelines, section 163.61-1) submit methods not only for the active ingredient, but for each identifiable impurity associated with manufacture of the technical chemical. Such methods have not been submitted for any ethoxyquin formulation.

Physical and Chemical Properties [163.61-8]

For every pesticide product, the Proposed Guidelines would require data on certain physical and chemical properties useful for identification purposes or for evaluation of hazard potential. Data on the physical and chemical properties of substances used to impregnate wraps are required if the substance is not substantially similar to a product for which the Agency has acceptable data.

Required Physical/Chemical Properties: Color, odor, density or specific gravity, pH, storage stability, flammability, oxidizing or reducing action, explosiveness, and corrosion characteristics.

V

ENVIRONMENTAL FATE

A. Use Profile

Ethoxyquin formulations are applied to apples and pears by preharvest spray and post-harvest dip or spray. Ethoxyquin is also impregnated on paper wrappings to prevent scald, post-harvest.

There are two types of ethoxyquin products currently registered to treat apple and pear scald. Five companies have labels for emulsifiable concentrates containing from 52.2 to 70% active ingredient.

Current registrations for ethoxyquin include "No Scald Ethoxyquin" (Chemley Products Co., EPA registration number 4543-9) and "Deccoquin 305 Concentrate" (Pennwalt Corp., EPA Registration number 4581-316), basically dominating the market where drenches, sprays, dips, and waxes are used. Both are available in 5 gal. cans ready to dilute with water in treatment tanks. Two companies have labels for paper wraps. Only one company (Crown Zellerbach) still actively markets its wraps; "Crownoil Apple Wraps" (EPA registration number 3222-9), "Green Crownoil Pear Wraps" (EPA registration number 3222-6). The wraps are available as individual sheets ranging in size from 9 x 9 to 14 x 12 inches. All of the above formulators apparently obtain their ethoxyquin from the primary manufacturer, the Monsanto Company.

State and Federal recommendations and other literature sources list preharvest and postharvest sprays, postharvest drenches and dips, wax dips, and paper wraps as means for treating fruit with ethoxyquin. In current practice preharvest sprays are apparently not used. The most commonly used treatment method is a fruit drench in an ethoxyquin aqueous solution at the packinghouse. In this method bulk bins of recently harvested fruit are flooded for several seconds with the treatment then allowed to drain for a few minutes before removal (usually by forklift) to cold storage. Excess solution is recovered and recycled for immediate re-use. Recommended ethoxyquin concentrations are between 2000 to 2700 ppm active ingredient. The solution often contains a surfactant and an antifoaming agent. It is also normal practice to add one or more antirot fungicides to the mix such as captan (1 lb/100 gal) and/or benlate (6-8 oz/100 gal).

A small number of packinghouses dip their harvested apples in similar solutions. Typically a forklift places a bulk bin into a tank of ethoxyquin for a period of 15 seconds to 2 minutes, depending on the temperature of the solution. In all application types, fruit are only treated once.

Accurate data on number of workers and fruit packinghouses using ethoxyquin fruit treatment are not available. An estimate of apple packing-houses in this country is between 500 to 1000. The number of workers exposed to ethoxyquin per packinghouse varies with the treatment as will be explained in the following treatment descriptions.

Fruit Wrapping is principally done at some 40 packinghouses handling 'Anjou' pears. An estimated 20 to 90 Sorter/Wrappers (typically women) per house handle wrappers. Wrapping continues 8 hr/day during a 1-2 month harvest season. Workers usually wear gloves, but these are primarily to protect the fruit from bruising, not as a protective device. All labels contain the warnings, "Keep out of reach of children" and "Wash hands before eating".

In ethoxyquin drench or dip operations only 2-3 workers per packinghouse engage in treatment of apples. Typically these operations are performed outdoors and involve maneuvering truckloads or bulk bins through drench showers or into dipping tanks. Forklift operators, machine operators, and truck drivers are all potentially exposed to some spray and liquid. Most of these operations are at least partially automated. For example, bins and truckloads of fruit are dragged through drenches by motorized chains operated by a worker at a control board. Individual apples in these methods are seldom handled until after storage when they are sorted and packed for shipment. There are an estimated 500 to 1000 packinghouses using these methods. Except for gloves normally worn by fruit handlers, protective clothing is not usually worn.

Spray, brush, or wax operations are usually located inside the packinghouse but are separated by walls from most of the workers. One or two workers are potentially exposed to ethoxyquin in liquid or wax, as they oversee the operation of the belt line. One of these workers usually is responsible for adding and mixing of fresh ethoxyquin solution. Sprays are stream-like rather than a fine mist. After the fruit is dried, it is handled by sorter/packers. These workers usually wear gloves but no other protective clothing. Wax treatment of the fruit may be somewhat tacky at this stage. Approximately 40 to 80 packinghouses use these treatment methods.

B. Manufacturing-Use Ethoxyquin

1. Environmental Fate Profile

There are no data currently available on the environmental fate of Ethoxyquin.

2. Exposure Profile

Because of the scarcity of data on the environmental fate of Ethoxyquin, it is impossible to quantitatively assess exposure of humans and wildlife to manufacturing-use Ethoxyquin.

3. Data Requirements and Data Gaps

Since the outdoor spray (preharvest) use of ethoxyquin is reportedly discontinued, and in light of the low market volume and use patterns of ethoxyquin which indicate minimal exposure, environmental fate data requirements may be waived, if this use is dropped from the label. (See Chapter 3).

C. Formulations of Ethoxyquin

General information relating to the emulsifiable concentrate and impregnated wrap ethoxyquin and specific label recommendations and precautionary statements relating to their uses may be found in Chapter 2 of this Standard.

1. Exposure Profile

Emulsifiable concentrate (EC) formulations and impregnated fruit wrappings containing ethoxyquin are registered for control of a physiological disorder called "scald" on apples and pears. The EC formulations are applied by spray, dip, brush or flood techniques. Application rates are recommended at 1.5 and 2.25 lb. a.i./100 gallons of water. Since it is reported that preharvest sprays are apparently not used in current practice, all of the EC formulation is used for postharvest treatment of fruit intended for storage. Paper products impregnated with between 0.04 and 0.131% ethoxyquin are registered for use as fruit wraps.

All formulations:

The potential exposure by inhalation of volatilized ethoxyquin cannot be assessed due to the lack of vapor pressure and volatility data on either the manufacturing-use product or formulations. Hydrolysis data which could provide identification of possible pesticide related products formed in application solutions are also lacking. Since the use of ethoxyquin formulations for preharvest foliar applications is reported not to be a current practice, the direct contamination of soil or natural water from registered uses of ethoxyquin is unlikely.

As with most pesticides, the greatest human exposure will probably be to those workers engaged in mixing, loading, and treatment operations. However, quantitative data are not available to estimate the degree of such exposure. The principal regions of use of ethoxyquin are in the apple-growing areas from Virginia north through New York State and Massachusetts and the apple and pear producing regions of Washington and Oregon. Treated fruit which may bear residues of ethoxyquin are available to the general population.

Data on the metabolism of ethoxyquin indicate that it can selectively alter aflatoxin conversion in *Aspergillus parasiticus* strains that synthesize both B and G type toxins. Large increases in the more potent B type may be due to inhibition of the organism's conversion of aflatoxin B to G. Thus increases in aflatoxin residues on *Aspergillus*-contaminated food crops treated with ethoxyquin appear to be possible.

The potential for human exposure (inhalation and dermal) during loading, mixing and application operations is recognized. For drench and dip operations, 2-3 workers are closely involved in the treatment of apples in each of an estimated 500 to 1000 packinghouses using these methods. Operations are typically performed outdoors with forklift operators, machine operators and truck drivers all potentially exposed to some spray and liquid. Individual apples are seldom handled until after storage when they are sorted and packed for shipment. Except for gloves normally worn by fruit handlers, protective clothing is not usually worn. Spray, brush or wax operations are usually performed inside the packinghouse where one or two workers are potentially exposed to ethoxyquin in each of the approximately 40 to 80 packinghouses which use these treatment methods. These workers are usually responsible for adding and mixing fresh ethoxyquin solution. Fruit is handled by sorter/packers who usually wear gloves but not other protective clothing.

In summary, about 1000-3000 workers are involved in the application of ethoxyquin to fruit using EC formulations. The presence of liquids and sprays containing the active ingredient is a potential source of dermal and inhalation exposure to all of them. An undetermined number of sorter/packers who usually wear gloves are exposed to a lesser degree. Residues on fruit surfaces would be a source of slight dermal exposure to humans during marketing and consumption.

Impregnated material (Paper fruit wrap)

Fruit wrapping is presently performed in some 40 packinghouses handling "Anjou" pears. An estimated 20 to 90 sorter/wrappers (typically women) per house handle the wrappers. Wrapping continues 8 hr/day during a 1-2 month harvest season. Workers usually wear gloves but not other protective gear. Residues of ethoxyquin transferred to fruit from treated paper wraps may be a source of slight dermal exposure during marketing and consumption, but the dietary contribution is extremely low.

VI

TOXICOLOGY

A. Manufacturing-Use Ethoxyquin

1. Toxicology Profile

The chronic no-observed effect level for ethoxyquin is 0.0062%. Acute oral data, although insufficient in detail, indicates low acute oral toxicity (LD50 in rats: 3150 mg/kg).

2. Data Requirements and Data Gaps

The toxicology data requirements and data gaps are listed in Chapter 3 of this Standard.

Since no manufacturing-use Ethoxyquin is currently registered, these data requirements would automatically become data gaps in the event an application for registration was filed for a manufacturing-use chemical.

Food Use (Requires a Tolerance or Exemption)

All applicants for registration of technical products which are formulated into end-use products intended for use on food must submit or cite the following:

Category of Test	Description	Data Requirement
Chronic Feeding (163.83-1)	A two year feeding study in the rat.	Satisfied
Oncogenicity (163.83-2)	An oncogenicity study in each of two suitable mammalian species.	Satisfied
Teratogenicity (163.83-3)	Teratogenicity testing in two mammalian species.	Satisfied
Reproduction (163.83-4)	A two-generation reproduction study, preferably in the rat.	Satisfied

Mutagenicity (163.81-1 through 163.81-4)	A mammalian in vitro point mutation test; a sensitive sub-mammalian point mutation test; a primary DNA damage test; a mammalian in vitro cytogenetics test.	Satisfied
Metabolism (163.85-1)	A general metabolism study in one mammalian species.	Satisfied

Human and Domestic Animal Hazard Assessment

Since no manufacturing-use Ethoxyquin products are currently registered, potential acute, sub-acute or chronic effects in humans and animals cannot be assessed.

Required Labeling

Precautionary labeling of each product must correspond to the toxicity categories determined by five acute toxicity tests. Acceptable categories of acute toxicity and the corresponding required labeling appear in the Chapter 2 of this Standard.

3. Topical Discussions

Corresponding to each of the Topical Discussions listed below is the number of the section(s) in the 'Proposed Guidelines' of August 22, 1978 (43 FR, No. 163 37336) which explain(s) the minimum data that the Agency usually requires in order to adequately assess ethoxyquin's toxicology. Where no section number is listed, a minimum requirement has not been set for such information.

The topical discussions describe available toxicity data on technical ethoxyquin and its formulations and state whether they are adequate for Agency regulatory purposes should application be made for registration for a manufacturing use Ethoxyquin.

Acute Oral Toxicity (163.81-1)

The minimum testing needed on acute oral toxicity is one test, in the laboratory rat, on the technical chemical and on each manufacturing-use product.

No adequate data were available for adequately assessing the acute oral toxicity of technical Ethoxyquin; testing is required. However, the available data do indicate a low oral toxicity. A Russian report which has insufficient details gives oral LD50's of 3150 mg/kg for rats and 3000 mg/kg for mice (Kellman, G.Y., 1965, MRID# 05000684). The acute oral LD50 for chickens has been reported to be 8-10 gm/kg, suggesting a low acute oral toxicity in chicks (Gassner, 1960; MRID# 05000517; and Colorado Agricultural Research Foundation, 1951; MRID# 00001917).

Acute Dermal Toxicity (163.81-2)

The minimum testing needed on acute dermal toxicity is one test, preferably in the albino rabbit, on the technical chemical and on each manufacturing-use product.

No tests on technical ethoxyquin are available.

Acute Inhalation Toxicity (163.81-3)

The minimum data requirement for acute inhalation toxicity is one test, preferably in the albino rat, on the technical chemical and on each manufacturing-use product. There was one study using technical ethoxyquin (Scientific Associates, 1960, MRID #00002202). Seven males and eight female rats were exposed 6 hours to 15.54 mg./liter (ca. 1750ppm.), then observed for 14 days. Droplet size was 1 to 6.75 micron (90-92% 2-4u). No ill effects were observed. Necropsies revealed no macroscopic systemic damage. This study fulfills the data requirement.

Primary Eye Irritation (163.81-4)

The minimum testing needed to evaluate eye irritation potential is one test, in albino rabbits, on each manufacturing use product. If the test substance has a pH of 1-3 or 12-14, however, it will be judged corrosive, and an eye irritation test is not needed. If the test substance has been judged to be dermally corrosive, an eye irritation test is not needed.

No data were available for assessing the primary eye irritation of technical Ethoxyquin.

Primary Dermal Irritation (163.81-5)

The minimum testing needed to evaluate dermal irritation potential is one test, preferably on the albino rabbit, on each manufacturing use product. No data were available for assessing primary dermal irritation of technical ethoxyquin.

Skin Sensitization (163.81-6)

The minimum requirement for assessing skin sensitization is an interdermal test in one mammalian species, preferably the guinea pig, on each manufacturing-use product. Skin sensitization was studied by the method of Draize, Woodward and Calvery (MRID #0500474). Ethoxyquin was mixed with an equal amount of Tween 80 and suspended in saline for injection. No sensitization developed. This is an acceptable laboratory sensitization test. Nevertheless, note human experience discussed in the supplementary information section at the end of this Chapter.

Subchronic Testing

Subchronic Oral Toxicity (163.82-1)

The minimum data requirement for subchronic oral toxicity is one test for the technical formulation in two mammalian species, preferably using the rat and dog.

Twelve studies relating to the subacute oral toxicity of ethoxyquin were reviewed. They are listed on the following table.

Subacute Oral Dosing Studies Reviewed

Studies	Authors	Species	MRID Number
1.	Panner and Packer	rat	05000529
2.	Kellman	mouse & rat	05000684
3.	Parke, Rahim and Walker	rat	05000411
4.	Walker, Rahim and Parke	rat	05000440
5.	Parke, Rahim and Walker	rat	05000450
6.	Skaare, Nafstad and Dahle	rat	05001835
7.	Takahashi and Hirago	rat	05012507
8.	Gordon and Machlin	dog	00001932
9.	Whanger, Wesig, Oldfield, Cheeke and Schmitz	lamb	05000420
10.	Colorado A & M University	chicken	00001919
11.	Poultry Producers of Central California	chicken	00001920
12.	Gassner, Buss, Hopwood and Thompson	chicken	05000517

Seven studies assessed the effects of ethoxyquin on rats; one study each tested the effects of ethoxyquin on dogs and lambs and three studies assessed the effects of ethoxyquin on chickens. None of these reviewed studies met the standards of the subacute oral toxicity testing. The first study (Panner and Packer, MRID #05000529) examined the effect of Flector H on hepatic alterations in both male and female rats fed 1.5 or 3.0% of the compounds for up to one month. The study showed that Flector H is capable of causing gross as well as microscopic alterations in the livers of rats. Inadequate information about the preparation used was one of the drawbacks of this study. Kellman (MRID #05000634) undertook subacute toxicity study of Santoflex by the oral route of lower dose (1/5th of the LD_{50}) for one month in both rats and mice.

No serious consequences were observed in the one month feeding studies using doses of 1/5th the LD_{50} The details of techniques were sketchy. Both mice and rats were used in this study, but strains, sexes, and numbers of animals used were not given. In addition details pertaining to how the compound was administered were not available. The third study (Parke, Rahim and Walker, MRID #05000634) reported that all of the hepatic changes (e.g. hyperplasia, hypertrophy and increased enzyme levels) induced by ethoxyquin were reversible once the ethoxyquin was removed from the diet for weanling male Wistar rats which were fed for 14 days on a diet containing 0.5% ethoxyquin. The fourth study (Walker, Rahim and Parke, MRID #05000440) reported that in rats receiving dietary levels of 0.5% ethoxyquin from weaning for a duration of 60 days, ethoxyquin caused an increase in relative liver weight, in the amount of microsomal protein, cytochromes P-450 and b5, and in the activity of biphenyl-4-hydroxylase. The toxicity study and detail of experiments were not reported in this study.

In the fifth study, Parke, Rahim and Walker (MRID #05000450) showed ethoxyquin caused hypertrophy of the liver and induction of hepatic mixed function oxidase system of weanling male Wistar rats fed 0.5% ethoxyquin for 14 days. A biphasic recovery also was observed during a 30 day recovery period. The sixth study (Skaare, Nafstad and Dahle, MRID #05001835) reported that ethoxyquin administered prior to dimethylnitrosamine increased hepatic necrosis. In this study, 5 to 7 week old male albino rats were fed ethoxyquin (37.5 mg/kg) for 2 months prior to the administration of dimethylnitrosamine, 30 mg/kg, i.p. The seventh study Takahashi and Hirago (MRID #05012507). Male rats were fed approximately 3.15 moles/kg./day of purified Ethoxyquin for three weeks and the following results were reported: Hemmorhages in the epididymis or testis and the prothrombin index was significantly decreased. The experiment appears to have been conducted in a valid fashion, although a number of details needed for a thorough evaluation are missing. Note that the dose used was quite high compared to effect levels reported in other studies. Gordon and Machlin, (MRID #00001932) fed dogs ethoxyquin in an egg yolk-milk or meat diet for 7 or 4 days did not show accumulation of ethoxyquin in the liver. The study failed to report the grade of ethoxyquin used and the sex of dogs used. There was neither clinical testing nor necropsies nor histopathology performed.

The ninth study in this series (Whanger, Wesig, Oldfield, Cheeke and Schmitz, MRID# 05000420) reported that 500 mg of ethoxyquin three times a week was well over the LD_{50} value for lambs. Dosage cut back to 250 mg three times a week resulted in no reported mortality. The tenth study (Colorado A & M University, MRID #00001919) examined the subacute toxicity of Santoquin on the chicken. Subacute feeding of Santoquin at levels ranging from 0.015 to 1.5% for 12 weeks had no effect on body weights, feed consumption and livability. Histologically, the liver, spleen, kidney, thyroid and testes were also normal. The eleventh report (Poultry Producers of Central California MRID #00001920) also investigated the toxicological effects of ethoxyquin (0.0075, 0.075 and 0.15% Santoflex in diet) on leghorn cockerels starting from one day old. At the end of the eight week period, there were no significant differences among the various groups as to weight gain and feed consumption. Further, no gross pathology of birds on eight week Santoflex treatment was noted. The last study (Gassner, Buss, Hopwood and Thompson, MRID #05000517) reported that there were no significant effects on growth and feed consumption of chicken fed different amounts of ethoxyquin (0.00075, 0.0015, 0.003, 0.0075 and 0.075%) in diet for 12 weeks. Tissues of chicken showed neither gross nor micropathologic changes. Because of ethoxyquin's low toxicity as indicated by chronic oral toxicity data, and by years of experimental use experience, additional testing is not required.

Subchronic Dermal Toxicity (163.82-2)

The minimum data requirement for subchronic 21-day dermal toxicity is one study for the technical chemical, preferably using the Albino rabbit.

One study (Wilson and DeEds, MRID #0500474) reviewed related to subacute dermal toxicity testing. In this study both rabbits and guinea pigs were used for the study of skin irritation. A single drop of the oily undiluted ethoxyquin was rubbed over an area of skin 2 cm. in diameter, daily 5 days per week for 2 weeks. This treatment produced a slight erythema followed by a papular eruption and occasional scab formation. The study also revealed that when treatment was stopped, the lesions disappeared, leaving a normal appearing skin after a few weeks. This study lacks details of techniques used, no sexes or number of animals were mentioned and no control animals were compared. The experiment did not follow the requirement of 21-day (163.82-2) or 90-day (163.82-3) periods.

Subacute dermal toxicity data conducted using experimental protocols acceptable by the guidelines are not available for ethoxyquin. The above study is only considered to be a preliminary study. However, because of ethoxyquin's low toxicity as indicated by acute and chronic oral testing in rats, further dermal testing is not required.

Chronic Testing

Chronic Feeding (163.83)

A chronic feeding study is normally required for all food uses in one mammalian species (laboratory rat) using the technical product. The study would normally be required for all food uses of ethoxyquin.

Data on a chronic feeding study would be required for the registration of each manufacturing-use product. Testing is usually required in at least one mammalian species (the species is normally the laboratory rat).

Equal numbers of males and females of each species and strain tested must be used. Dosing of rats begins as soon as possible after weaning and in any case before the animals are 6 weeks old.

Eight studies relating to chronic feeding testing of ethoxyquin were reviewed. Four of these studies met the species requirement of the Agency's Guidelines. Three studies which dealt with the chronic feeding of ethoxyquin in dogs and chickens could be regarded as supportive studies. The other article was a review of some of the individual studies. They are summarized in the following table.

Studies	Authors	Species	Duration	MRID Number
1	U.S. Agricultural Research Service, Western Utilization Research Branch	rats	715 days	00001923
2	Wilson and De Eds	rats	715 days	05000474
3.	Panner and Packer	rats	2 years	05000529
4.	Rudra, Dickerson and Walker	rats	500 days	05000419
5.	Hanzal	dogs	50-60 weeks	00001925
6.	Colorado A & M Uni.	chicken	70 weeks	00001919
7.	Gassner, Buss, Hopwood and Thompson	chicken	70 weeks	05000517
8.	Pascal (review article)	rats & chicken	715 days	05000412

The first study (U.S. Agricultural Research Service, Western Utilization Research Branch, MRID #00001923) reported that 5 to 10 rats of both sexes were fed different dose levels (0,0.0062, 0.0125, 0.025, 0.05, 0.1 and 0.2%) of ethoxyquin for 715 days. The study revealed that the animals on all dose levels appeared comparable to control rats of the same age. Mortality was not extreme until after the 700th day when an infection spread through the entire colony causing termination of the experiment. The main histopathological findings were in the kidney at the 0.2% level in females and 0.1-0.2% in male rats. The lesions were not more severe than those seen in comparable animals autopsied after shorter feeding periods (200 or 430 days). Proximal renal tube atrophy, renal tube dilation, widening of collecting tubules, and patchy lymphocytic and fibrous tissue infiltration were found. The main drawback of this study was the small number of animals used for the testing.

Wilson and De Eds (MRID #05000474) examined the chronic toxicity of ethoxyquin (0.0062-0.2% in the diet) in 270 weanling albino rats for up to 715 days. This study indicated that ethoxyquin incorporated into the diet exhibited a transient depression of growth rate of rats. Hemoglobin levels remained normal. There was no altered urinary excretion of hemoglobin or protein. Because of ethoxyquin metabolites, experimental urines were darker, blackened with time. The life span of animals was not altered. At autopsy, there appeared shallow pitting of the renal cortex in male rats receiving the higher dose levels for 200 or more days. Ambiguous increases in liver weights were observed in females. Increases in kidney weights in females and liver and kidney weights in males were observed. Microscopic examination revealed no lesions in females, but lesions in kidneys, livers, and thyroids of males. The kidneys of males showed irregular zones of fibrosis, tubular atrophy, focal tubular dilation and lymphocytic infiltration characteristic of chronic pyelonephritis. There was a dose response in the occurrence of these lesions. Groups of male hepatic cells showed rounded eosinophilic hyaline inclusions of different sizes up to the diameter of the cell nuclei. The thyroids of treated males showed decreases in stored colloid, with diffuse increase in height of the follicular epithelium, indicating mild hyperplasia. The no observable effect level (NOEL) was found to be 0.0062%.

Panner and Packer, MRID #05000529) reported the test of 35 male and 35 female rats which were maintained for 2 years on the following diets: control, 0.01% and 1.5% Flectol H. Only 3 males and 5 females given the 1.5% diet in the 2 year study survived to sacrifice. The study showed that ethoxyquin caused gross as well as microscopic alterations in the livers of both male and female Wistar rats. The specific signs were liver enlargement, fatty infiltration, necrosis and atypical biliary duct hyperplasia. These effects were most pronounced at a dietary level of 1.5%. The study lacks in the number of animals, dose selection and many points of the guidelines. The Fourth study (Rudra, Dickerson and Walker, MRID #05000419) reported the effect of ethoxyquin at 0.5% level on body weight and kidney in weanling male Wistar rats for 500 days. The study showed that ethoxyquin reduced weight increment and caused severe kidney damage. This study is of limited value since many areas of guidelines e.g. duration of testing, number of dose levels, both sexes of rats, observations of animals, etc. are lacking. The fifth study (Hanzal, MRID #00001925) reported that ethoxyquin produced substantial toxic effects in the liver and kidney at dose rates of 10 to 100 mg/kg/day. The associated stress of histoplasmosis (in one dog) appeared to enhance similar signs of toxicity at the lower dose rate of 3 mg/kg/day. These data provide a fair basis for speculating that the minimum effective dose of Ethoxyquin lies in a range below the 3-10 mg/kg/day oral dose given over a period of 50-60 weeks. However, a no-observed-effect-level was not found.

The sixth study (Colorado A & M University, MRID #00001919) reported the effects of ethoxyquin (0,0.00075 and 0.075%) on chickens. No effect on growth of the breeding flock was found during the 70 weeks study. The seventh study (Gassner, Buss, Hopwood and Thompson, MRID #05000517) also reported the effect of feeding ethoxyquin on chickens. In this study, 0.00075, 0.0075 and 0.075% ethoxyquin were used in the feed for 70 weeks. The results concluded that with graded levels up to 0.075% of ethoxyquin in the diet showed no significant effects on mortality, growth, feed consumption, livability, egg production, fertility of eggs and hatchability of eggs. Tissues of chickens showed neither gross nor micro-pathology which could be ascribed to the treatment. The study reviewed in the eighth article (Pascal, MRID #05000412) has been discussed in the previous studies (Wilson and De Eds, MRID #05000474 and Gassner, Buss, Hopwood and Thompson, MRID #05000517). The no observable effect level of 0.0062% found in the DeEds et. al. study for the rat is accepted, and satisfies this data requirement.

Oncogenicity (163.83-2)

Only one study (Wilson and De Eds, MRID #05000474) mentioned the presence of tumors in a report on chronic toxicity of ethoxyquin (0.0062-0.2% in the diet) in rats fed up to 715 days. The study stated that occasional tumors were present in the 700-day animals.

The study does not indicate that ethoxyquin has oncogenic potential, since tumors, particularily in this age group, are not unusual, and the incidence of occurrence was without relationship to dose level. Further testing is not required.

Reproduction Testing

Teratology (163.83-3)

No individual reports of tests satisfying the teratogenic guidelines were found. We do have information relating to teratogenic potential, which includes reproductive studies in rats and the use for many years of ethoxyquin as an additive in animal feeds.

Because rats tend to resorb rather than abort imperfect conceptus, the resorption in rats fed ethoxyquin was studied (Telford, I.R. et al, 1962, MRID# 05000428). A single dose of 0.25 grams (ca. 50 mg/kg.) was given after positive mating. Twenty days after positive mating, pregnant rats were killed and young delivered by caesarian section. There were no greater percent of absorption for the treated group than for the control group. No gross malformations were reported.

Ethoxyquin was fed to rabbits (Isenstein, R.S., 1970, MRID# 05000366) in amounts up to four times the amount used as a feed additive (0.01%; ca. 3 mg/kg/day). Treatment started 10 days before breeding and continued until 2 weeks after parturition. There were no abortions or gross deformities noted.

In addition, feed containing ethoxyquin added under FDA regulation has been fed to livestock for many years. No reports of harmful effects of any kind from such feeding have been found. Further testing for teratogenicity is not required.

Reproduction (163.83-4)

The minimum data requirement for reproduction is testing in one mammalian species, preferably the laboratory rat, using the technical formulation and lasting for two generations.

Nine studies relating to reproductive testing of ethoxyquin were available for review. Of the nine studies, one was a review article, five were reports submitted to Monsanto, and three were articles from the original literature. None of these studies met the requirements individually for reproduction testing.

MRID # 00001919 is a study of the reproductive effects of ethoxyquin on chickens. No effects on growth of the breeding flock were noted during the study. No effects could be attributed to ethoxyquin treatment on any of the parameters measured in this study (body weight, hatchability, etc.). MRID # 0001915 is a review article which considers work on the toxicity of ethoxyquin from 1951 to 1954.

Another study (MRID #0001933) was carried out with albino Sprague-Dawley rats. Animals were fed diets slightly deficient in vitamin E in which ethoxyquin was mixed to give the following dietary levels: 0,0.025 and 0.05%. Animal treatment groups consisted of from 8-19 animals each. Feeding the experimental diet was begun at 60 days of age and feeding of the ethoxyquin-mixture was continuous. Female rats were mated at 100 days of age (FO). After weaning, the females were bred two more times. In addition, progeny from the first mating were placed on the ethoxyquin diet for 100 days and mated at 100 days of age (F1). The number of litters and average litter size was recorded for all matings. The results indicated that diets containing ethoxyquin did not interfere with reproduction in rats. Instead, the ethoxyquin increased reproductive efficiency. This increase may have resulted because the diets were marginal in Vitamin E.

Initial treatment was at day 60 instead of day 40 and only two doses (instead of three) were used. This study does not meet the guideline requirements for a reproductive study.

A diet supplement study (MRID #00001934) in which ethoxyquin was fed to Sprague-Dawley rats from 60 days of age onward at a dietary level of 0.1%. Two matings were monitored. The animals receiving the experimental diets produced young and raised them successfully as did the controls. Offspring of animals receiving 0, 0.025 and 0.5% ethoxyquin in their diets were studied. Insufficient details are given to make this a meaningful report.

A study was carried out by the Wisconsin Alumni Research Foundation (MRID #0001924) with white albino Sprague-Dawley rats. Females believed to be pregnant from 1-10 days were grouped into 4-9 animals each and placed on test diets containing 125, 375 and 1125 ppm ethoxyquin. The number of young produced, the number of live young born, the number of animals living at 3 days, the number of animals weaned and the weanling weights were recorded. In a second study young adult virgin female rats were mated and placed into six experimental groups of 4-9 animals per group. The same diet regime as in experiment 1 was used. In addition to the parameters recorded in experiment 1, gestation time also was recorded. There appeared to be a reduction in the average number of young per litter in the ethoxyquin treated group; however, it was not dose-related and in fact the 125 and 325 ppm ethoxyquin-treated groups showed a greater reduction in litter size than did the higher dose level. There was a reduction in the number of live animals in experiment 2 at 1125 ppm ethoxyquin but this did not agree with the comparable group in experiment 1. Furthermore the high doses in experiments 1 and 2 did not agree. A possible explanation may be related to the lack of control mating and marking of pregnancy in the females in group 1. The numbers of animals that survived to weanling were not different in any of the groups with the exception of the 1125 ppm ethoxyquin treatment. The experimental protocol employed in this study did not conform to established EPA guidelines.

A study published in the American Journal of Anatomy (110:29-36) (MRID #05000428) dealt with fetal absorption in the rat as influenced by ethoxyquin. The data presented suggested that ethoxyquin offered some beneficial effects on the resorption rate; however, alpha and gamma tocopherol as well as other antioxidants were more effective. In this study Walter Reed-Carworth Farm strain rats in their first generation were used. They weighed approximately 200 g at the time of breeding. After positive mating, the females were randomly distributed into experimental and control groups and the experimental groups were given Ethoxyquin orally or it was placed into their diets. Twenty-two days after mating, the females were killed and the young delivered by Caesarian section. A careful microscopic survey was made for resorption sites and resorptions were charted as to location in the respective regions of the horns and classified as to degree of resorption. There were no adverse effects. This is not an acceptable reproductive study as now required by EPA guidelines.

A study published in the American Journal of Vet. Research (31: 907-909) (MRID #05000366) involved feeding ethoxyquin at levels up to four times normal to rabbits during pregnancy. Male and female New Zealand white rabbits were used, age unknown. Not all animals were virgins. Some of the animals used in the first experiment were re-used in the second experiment. The prior exposure of the animals to ethoxyquin if any, was not indicated. Female rabbits received experimental feed from at least 10 days before breeding to at least two weeks after parturition. Male rabbits received experimental feed for at least 10 days prior to breeding. There were 11-20 rabbits per group. There were no absorptions or physical defects noted. In the first experiment there were no differences in average litter size, gestation period and percentage of mortality at or following birth between experimental and controls. In the second experiment there was greater neonatal mortalilty in the groups which had not received ethoxyquin.

Finally a reproductive study which was published in the Journal of Agricultural and Food Chemistry (7:203-206) (MRID #05000474) deals with Sprague-Dawley rats which were on a diet containing 0, 0.025, 0.05 and 0.1% ethoxyquin. The animals were placed on their respective diets when 60 days old and received the diets continuously thereafter. The rats were mated when 100 days old, with four females and one male to a cage and rotation of the males once a week. After this mating, the rats receiving 0.1% ethoxyquin were discarded because this concentration seemed "unnecessarily high". After all litters were weaned, the rats were re-mated and following weaning of these litters, a third mating was initiated. In addition to the above, offspring of animals receiving 0, 0.25 and 0.05% ethoxyquin diets were saved from the first mating, continued on their respective diets and mated when 100 days old for a second generation study. There were no effects that could be related to ethoxyquin treatment.

Although the available studies do not individually meet current guidelines for reproductive toxicity testing, collectively they indicate no harm to reproductive ability should be expected.

Mutagenicity

The Agency's mutagenicity testing requirements are being revised. Only a single study relating to the mutagenic potential of ethoxyquin was reviewed (Joner, P.E., 1977; MRID #05000385). TA 1535, 1537, 1538, 98 and 100 of *Salmonella typhimurium* were used. The tests were performed with and without the addition of a PCB-induced microsomal mixed function oxidase system (S-9) obtained from rat liver. The test system utilizing the five strains of *Salmonella* , was run at 10, 100 and 1000 ug ethoxyquin per plate. The compound was not mutagenic in the tests. One hundred and 1000 ug of ethoxyquin per plate were toxic especially to trains TA 1535 and TA 100. Thus at high concentrations, ethoxyquin was toxic to the growth of *Salmonella* but was not mutagenic. In addition to the above test (Ames), other mutagenic testing may be required when guidelines have been revised. No testing is requested at this time.

Metabolism (163.85-1)

The minimum data requirement for metabolism is a single dose using the analytical pure grade of the active ingredient in the radioactively labeled form.

A study was conducted in the rat and cow (Wilson, 1959; MRID #05000475) using C^{14} ethoxyquin. Although this study does not meet data requirements for metabolism due to improper testing methodology (animals were exposed to diets containing ethoxyquin prior to the start of the metabolism study and metabolite investigation was incomplete), it did show that ethoxyquin was excreted in the urine and feces (rats received a single 1.5 mg dose; cows received a single 155 mg dose). In addition, metabolites found in the urine were water soluble (although individual metabolites were not isolated) and there was some indication of transfer and excretion in the milk of the cow.

Another study (Monsanto, 19??; MRID #00001935) was conducted using the dog. This study did show that labelled ethoxyquin was excreted in the urine (after collection for 24 hours) and 85% of the labeled ethoxyquin was excreted as a metabolite, suspected to be sulfate or glucuronide conjugates (the identification of the metabolites was incomplete). In addition, another dog was given labeled ethoxyquin and sacrificed at 4 hours. The liver and kidney were examined and labeled ethoxyquin was detected in these tissues. Chromatography demonstrated that the primary metabolites were glucuronides and sulfates.

Another study (TerMeulin and Walker, 1977; MRID #05002491) was conducted using the laboratory rat. Chromatography showed that metabolites (not identified) were present in the bile within 12 hours after the administration of labeled ethoxyquin.

Skaare, J.U., and Nafstad , I. (1979, MRID #05012506) studied the distribution of 5,7-(14C) Ethoxyquin in male rats. Two rats were sacrificed after oral intubation (104 mg./kg.-250u cu./kg.)at 0.5, 1, 2, 4, 8, 10, 12, 16, 20, 24, 48, and 144 hour intervals . Whole-body autoradiographs were made, and radioactivity in livers was measured. Radioactivity peaked in the liver between the first and fourth day(2-3% of dose). After 6 days, 0.2% remained. High radioactivity was reported to have remained in the renal cortex after 6 days.

No attempt to identify the compounds retaining the radioactivity was reported.

The above data is not sufficient to satisfy the data requirement as set forth in the guidelines for metabolism. However the data do indicate that ethoxyquin is metabolized to more polar compounds (conjugates with glucuronic acid or sulfate are the most likely metabolites) in the dog. Such metabolites have been identified in both tissue and urine in the dog. In addition, the rat also metabolizes ethoxyquin to more polar compounds, but the identification of the metabolites has not been made.

Additional metabolism testing is not required at this time.

B. Toxicology - Emulsifiable Concentrate Ethoxyquin

1. Toxicology Profile

The acute oral toxicity of 70% EC ethoxyquin is low based upon research by Younger, 1960, (MRID #00001880). Acute dermal toxicity is described as very low, according to a report by Scientific Associates, 1960, (MRID # 00001884). Acute inhalation testing showed no ill effects in rats (MRID #GS-0003-3). Primary eye irritation is described as mild by Younger, 1960, (MRID #00001880). Ethoxyquin is described as a mild primal dermal irritant by Younger, 1960, (MRID #00001880). Tests on dermal sensitization of ethoxyquin from manufacturing exposures indicate mild, non-persistant and unpredictable allergic dermatitis.

Chapter 3 contains data tables for emulsifiable concentrate showing which categories of test within the proposed guidelines are required for EC ethoxyquin, along with the guideline citation, composition characteristic, use pattern, whether or not the Agency has sufficient data to satisfy these requirements, and, if so, the bibliographic citation containing this information. The requirement for submission under FIFRA 3(c)2(B) and the amount of time allowed for submission is also listed in these data charts.

2. Topical Discussions

For information concerning subchronic and chronic studies using E.C. formulations refer to the Manufacturing-use Ethoxyquin section of this chapter, as data on the Manufacturing-use product may be extrapolated to end-use formulations for these data categories.

Topics

Acute Oral Toxicity
Acute Dermal Toxicity
Acute Inhalation Toxicity
Primary Eye Irritation
Primary Dermal Irritation
Skin Sensitization
Subchronic Dermal (21-Day) Toxicity

Acute Testing

Acute Oral Toxicity (163.81-1)

The minimum testing needed on acute oral toxicity is one test in the laboratory rat on each formulated E.C. product.

The acute oral toxicity of 70% E.C. Ethoxyquin (6 lb/gal.) in the laboratory rat is 3.3 g/kg (C.I. 3.0 - 3.6 g/kg) using Santoquin (6lb./gal.) (Younger, 1960; MRID #00001880). Toxic symptoms included diarrhea, lethargy, weight loss and collapse. No paralysis was noted. Principal autopsy findings were inflammation of the gastric mucosa and renal congestion upon microscopic examination. This information is sufficient to satify the data requirements for acute oral toxicity for the EC ethoxyquin and assign labelling Toxicity Category III, which corresponds to a low acute oral toxicity.

Acute Dermal Toxicity (163.81-2)

The acute dermal LD_{50} in rabbits is greater than 8 g/kg using EC Santoquin (A.I. 70%) (Younger 1960; MRID #00001884). Toxic symptoms were lethargy and temporary loss of appetite. This information satisfies the data requirement to assign labeling Category IV; very low acute dermal toxicity.

Acute Inhalation Toxicity (163.81-3)

A study using the emusifiable concentrate (Scientific Associates, 1960, MRID #GS-0003-4) was reviewed. Seven male and eight female rats were exposed for 6 hours to 0.120 mg./liter (ca. 24ppm) solutions. Droplet size was less than 1 to 7 microns(90-95%-1.75-3.5u). All rats survived the dosing and were observed for 14 days. There were no signs of ill effect. Although the study had only one dose level, it is acceptable for current use patterns.

Primary Eye Irritation (163.81-4)

A primary eye irritation study was conducted on rabbits (Younger 1960; MRID #00001884). In the study 100 mg of EC Santoquin (A.I. 70%) was applied to the rabbit eye resulting in mild eye irritation.

The above information is sufficient to satisfy the data requirement for primary eye irritation and assign labeling Toxicity Category III, corresponding to a mild eye irritation potential.

Primary Dermal Irritation (163.81-5)

A primary dermal irritation study was conducted on rabbits (Younger 1960; MRID #00001884). In the study an unspecified amount of EC Santoquin (A.I. 70%) was applied to rabbit skin resulting in mild dermal irritation at 24 hours and no irritation at 72 hours.

The above study is not sufficient to satisfy the data requirement for primary dermal irritation due to lack of reporting of the amount of substance applied. However, the data suggests that EC Santoquin (A.I. 70%) is a mild skin irritant. Additional testing is not required.

Dermal Sensitization (163.81-6)

The minimum data requirement for dermal sensitization is an intradermal test for the manufacturing-use product and each registered product, preferably using the guinea pig.

No laboratory data were available for assessing dermal sensitization of EC Ethoxyquin, however epidemiological information from manufacturing exposure indicated mild, non-persistent and unpredictable allergic dermatitis. Therefore, further testing is not required.

Subchronic Testing

Subchronic 21-Day Dermal Toxicity (163.82-2)

The minimum requirement to assess subchronic 21-day dermal toxicity is one study, preferably in the albino rabbit, on each EC formulation of ethoxyquin if any of its constituents is likely to increase skin absorpt or to potentiate toxic and pharmacologic effects. The Agency will evalu need for this study on a case-by-case basis as registrants apply for registration under this Standard. This data requirement is waived for existing products based upon the Acute Dermal Toxicity Category to which EC ethoxyquin is assigned (Category IV - very low acute dermal toxicity).

C. Toxicology - Impregnated Wraps

1. Toxicology Profile

Fruit wrapping is performed in some 40 packinghouses handling "Anjou" pears. An estimated 20 to 90 sorter/wrappers (typically women) per house handle the wrappers. Wrapping continues 8 hr./day during an 1-2 month harvest season. Workers usually wear gloves but not other protective gear. Residues of ethoxyquin transferred to fruit from treated paper wraps may be a source of slight dermal exposure during marketing and consumption. If registrants can demonstrate that the material used to impregnate wraps is substantially similar to the technical or manufacturing-use formulations, the toxicology data requirements for the impregnated wraps will be waived.

D. Supplementary Information

These topics are provided as supplementary information in conjunction with the topical discussions, particularily in the area of Dermal Sensitization.

Topic 1: Induction of Mixed Function Oxidase Enzymes (MFO)

Four studies were reviewed for the effect of either single or repeated administration of ethoxyguin on induction of mixed function oxidase system. Three of these studies (Walker, 1973; MRID #0500440; Kahl and Netter, 1977; MRID #05000670; Netter, 1978; MRID #05001765) examined the effect of ethoxyquin on hepatic mixed function oxidase activity in the laboratory rat. Principal findings are that ethoxyquin administered either as a single dose or in the diet for up to 14 days causes induction of cytochrome P-450 enzyme systems. Ethoxyquin is a phenobarbital type inducer of cytochrome P-450.

The fourth study in this series (Parke, 1974; MRID# 05000449) examined the possibility that ethoxyquin inhibits mixed function oxidase enzymes. These investigators using either a single administration of ethoxyquin or repeated dietary exposure to ethoxyquin demonstrate that ethoxyquin interferes with certain mixed function oxidase enzymes when administered continuously in the diet.

The above information indicates that ethoxyquin is capable of modulating hepatic mixed function oxidase enzymes. In addition, there is preliminary evidence that suggests prolongation of the life-span of "aging" rats upon exposure to small levels of dietary ethoxyquin and continuous administration results in enhancement of drug metabolizing enzymes in the liver.

Topic 2: Potentiation

One study (Skaare, 1977; MRID#05001835) was reviewed. This study examined the potentiation of dimethylnitrosamine toxicity after administration of ethoxyquin in the laboratory rat. Principal findings indicate that prior exposure to ethoxyquin either in the diet (500 ppm) or as a very high acute dose (500 mg/kg, p.o.) increases hepatic necrosis and accompanying sequelae due to subsequently administered dimethylnitrosamine.

Topic 3: Human Epidemiology (Dermal Toxicity)

There are no requirements in the federal pesticide guidelines for human epidemiological studies. Nonetheless, there are several reports in the literature of various dermatological disorders probably related to exposure to ethoxyquin. These human exposures and reactions have been reported superficially, but should be noted. There are 10 reports of human exposures to ethoxyquin in the workplace (mostly animal feeds) which have resulted in skin disorders. They are:

Authors	File No.
Mehlhorn and Beetz	05000401
Koziak and Sesevicak	05000394
Schubert *et al*.	05000543
Zachariae	05000444
Burroughs	05000669
Jung	05000386
Garasek and Kolensky	05000384
Scott and Dawson	05000421
Kelly	GS-0003-3
Fisher	05000618

All of these "studies" are essentially clinical reports of individuals who developed dermatitis while working in a situation that would expose them to ethoxyquin and perhaps other compounds. In some cases skin testing (patch test) was done to document the allergic response (contact dermatitis) to ethoxyquin. In one study (File No. 421) ethoxyquin was used as a "positive control" in a photo patch test study. All of the ethoxyquin responses were negative, except for these photo patch tests.

In summary, these reports constitute a sizeable body of evidence which suggests that ethoxyquin can be responsible for a dermatitis. Transfer of a worker to a site free from ethoxyquin "cured" some of these difficulties.

All of the data presented above represent an augmentation to other studies and supply additional data which may be valuable in the future. Evidence of human dermal reactions (probably allergic) should be noted.

VII

RESIDUE CHEMISTRY

A. Residue Chemistry - Manufacturing-Use Ethoxyquin

1. Residue Chemistry Profile

Ethoxyquin is used to prevent scald in apples and pears during storage. As an anti-oxidant it is also a food additive in animal-feeds (21 CFR 573.380), and in certain dehydrated forage crops (21 CFR 573.00), but these uses are not being considered in this standard.

Ethoxyquin formulations are applied to apples and pears by spray pre-harvest or as a dipping solution, post-harvest. Ethoxyquin is also impregnated on paper wrappings to prevent scald, post-harvest.

Residues found in pears and apples are principally Ethoxyquin. There are no data on the degradation of Ethoxyquin in treated apples and pears. In feeds fortified with ethoxyquin, degradation products have been reported but not identified.

International (Codex) tolerances of 3 ppm have been recommended for residues of ethoxyquin in or on apples and pears. The United States has indicated its acceptance of these Maximum Residue Limits (MRL), which are the same as the U.S. tolerances.

Whenever a pesticide is used on apples the Agency normally requires data on whether residues in apple pomace, a feed item, are transferred to meat, milk, poultry, and eggs; however, the Agency is not requiring such data to support the use of ethoxyquin on apples.

Ethoxyquin is used (up to 150 ppm) in animal feeds (21 CFR 573.380) and dehydrated forages (21 CFR 574.400). Tolerances for residues in eggs, meat, milk and meat by products have been established to provide for such feed additive uses (21 CFR 172.140). Assuming that the 3 ppm tolerance in whole apples is not exceeded, the feeding of apple waste will not result in over-tolerance residues in milk, eggs, meat, and meat by-products.

In addition, apples treated with ethoxyquin are likely destined for the fresh market, and little or no production of pomace is expected.

In studies with chickens using Ethoxyquin-2,4-^{14}C, 97% of the radioactivity is recovered in fecal material. Degradation products in feces, with similar R_f values as Ethoxyquin, were concluded to be conjugates of Ethoxyquin.

The regulatory method for ethoxyquin in/on apples and pears (PAM, Volume II) is a fluorometric method, modified from the original method of Bickoff, et al., (Anal. Chem. 28, 376 (1956), and is adequate for enforcement purposes, assuming that Ethoxyquin per se is the predominant residue. Residues in apples dipped in 3000 ppm Ethoxyquin averaged 2.90 ppm. The pre-harvest spray at 3000 ppm of Ethoxyquin resulted in no residues (method sensitivity not reported).

Residues in pears dipped in 3000 ppm of Ethoxyquin showed 0.03 ppm 53 days after application.

Ethoxyquin residues were found in milk of cows fed 150 ppm Ethoxyquin for 13 consecutive days. Ethoxyquin residues were found in calf, pig, and lamb livers fed as little as 30 ppm Ethoxyquin for 10 days. The residues consist mainly of Ethoxyquin, with less than 3% comprising the degradation products and possible conjugates of Ethoxyquin.

2. Data Gaps (See Chapter 3)

The following data are required to support a registration standard for Ethoxyquin:

(1) Data on the degradation of ethoxyquin in or on apples and pears subjected to typical commercial storage conditions are required. No data are available.

If the required data identify degradation products considered toxicologically significant, analytical methods for their determination will be required.

(2) Additional residue data on the level of residues in or on ethoxyquin treated apples and pears are required. Only a fraction of the available data reflect maximum allowable application rates.

3. Topical Discussions

Use Patterns and Restrictions

Ethoxyquin is formulated as an emulsifiable concentrate (EC) containing from 52.2% to 70% of the active ingredient. Formulations containing the active ingredient Ethoxyquin, may be used as a spray pre-harvest on apples and pears or as a dipping solution, post-harvest, with concentrations of active ingredient Ethoxyquin, varying from 1.5 lb-2.25 lb/100 gals. water.

The active ingredient is also used to impregnate fruit wrapping paper at concentrations of 0.04% to 0.131%.

Use restrictions specify that:

(a) Applications to specific varieties of apples and pears specified on the labels are intended to prevent fruit injury to susceptible species .

(b) Spray treatment application should be made only when the daily maximum temperature remains below 85°F, with one application within two days before harvest.

(c) fruit wrapped with impregnated material should not have been previously treated with Ethoxyquin.

Ethoxyquin is to be kept out of drinking water or water used for domestic purposes, and not applied directly to lakes, streams, and ponds.

1. Metabolism in Plants

The data on metabolism and breakdown of Ethoxyquin is limited. No metabolites have been reported.

Alfalfa meal was fortified with ^{14}C-Ethoxyquin and stored at room temperature for nine days. The meal was extracted with ether, and the extract analyzed by radiochromatographic and fluorometric methods.

Two oxidation products of Ethoxyquin were detected but were not otherwise identified (MRID #06001905).

A comparison IR and UV spectra of "aged" Ethoxyquin, extracted from feeds with "freshly distilled Ethoxyquin" indicated that there were no major degradative changes. The degradative products were not identified (MRID #00001906).

The limited amount of information presented gives no indication of identity of "reaction products" remaining following "aging" of Ethoxyquin. There are no radiotracer studies of plant metabolism with respect to uptake and translocation of Ethoxyquin.

We conclude that metabolism of Ethoxyquin in plants is not adequately defined.

2. Analytical Methods

Until clarification of metabolic pathways and/or degradation of Ethoxyquin residues in plants and animals has been presented, Ethoxyquin remains the residue of concern.

The regulatory method for ethoxyquin per se in PAM Volume II and the method used to obtain data on residues of ethoxyquin in apples and pears is a fluorometric method based on that of Bickoff et al (Anal. Chem. 28, 376 (1956), MRID# 00001889).

3. Residues in Apples and Pears

The data of MRID #00001377 is pertinent to the registration standard of Ethoxyquin but is an estimate and cannot be verified.

Five varieties of apples and one variety of pears were treated as follows with up to 3000 ppm of Ethoxyquin. Apples were sprayed 0-7 days before harvest, sprayed 0-1 day post harvest, or dipped for 15 seconds into a solution of Ethoxyquin. Pears were sprayed 5-7 days before harvest. Formulation used was Stop-Scald-EC with 70% Ethoxyquin. Pre-harvest treated apples and pears were analyzed 19-27 days after treatment, post-harvest apples were analyzed 20-23 days after treatment; and dipped apples 4 days after treatment. Storage conditions for apples are unknown. Maximum residues resulted in apples dipped in 3000 ppm Ethoxyquin, in which peels averaged 2.75 ppm; in the fruit 0.15 ppm. All other samples had corresponding residues. The pre-harvest spray (3000 ppm of Ethoxyquin)resulted in no residues (method sensitivity not reported). The possibility of volatilization or degradation to non-fluorescent products is suggested (MRID #00001889).

Pears were treated with Ethoxyquin either by pre-harvest spray or post-harvest dip. They were analyzed by the fluorometric method (MRID #00001889), 25 to 63 days after treatment. Formulation used was Stop Scald-EC with 70% active ingredient. The pears were treated with up to 2000 ppm of Ethoxyquin. Following post-harvest dip, the pears were analyzed 53 days later, with maximum residues of 0.03 ppm in whole fruit including peel. Following spray, samples analyzed 25-27 days after treatment had maximum residues of 0.04 ppm; no residues were detected 61-63 days after treatment. Data for blank samples or sensitivity of method were not given. No information was given as to storage or storage stability of Ethoxyquin (MRID #00001890).

Hartman and Crownoil paper wraps were impregnated with from 1 mg to 2.5 mg of Ethoxyquin. Anjou pears were wrapped with the impregnated paper and stored for 8 months. Analysis showed that the Hartman wrap left no Ethoxyquin residue on pears. Crownoil wraps left an average of 1.5 ppm on pears. Data for blanks samples and sensitivity of method not given (MRID #00002198). The data requirements are not satisfied by this study.

B. Residue Chemistry - Formulated Ethoxyquin

1. Registration Requirements

For future registration of a pesticide product for use on a food or feed crop not covered by this Standard, the Agency must be provided with data on metabolism of the pesticide in plants, and when appropriate, in animals; a validated method for analysis of pesticide residues in or on raw agricultural commodities, and residue data reflecting the proposed use of the pesticide on the crop.

2. Required Labeling - Emulsifiable Concentrate

Labels on Emulsifiable Concentrate Ethoxyquin used for direct application to fruit must contain a restriction against the use of impregnated wraps at a later date.

Impregnated Wraps

Wraps impregnated with Ethoxyquin intended for use on apples and pears must bear a label restriction against application to fruit which has been pre- or post-harvest dipped or sprayed with liquid formulations.

VIII

ECOLOGICAL EFFECTS

A. Ecological Effects Profile

Although no data are available on ethoxyquin toxicity to non-target organisms, an assessment of potential hazard can be made by examining information on use patterns. The use pattern profile indicates that ethoxyquin is used as a post-harvest dip or spray on apples and pears, and as a fruit wrap for use on apples and pears.

The use of wraps appears to present mimimal exposure to aquatic or terrestrial habitat, therefore, wraps should not present an adverse impact. The other uses, as well as the treatment of wraps, may expose non-targets either directly from application or through dissipation from treatment sites. Due to the absence of data on Ethoxyquin, a hazard assessment on these uses cannot be made at this time.

The preharvest spray use is reportedly no longer practiced in the orchard industry, but this use still appears on the label. If this use is dropped from the label, the major route of exposure to non-target organisms will be substantially reduced.

Based upon the status of ethoxyquin as a minor use pesticide (see Chapter 2) and the elimination of this major route of non-target exposure, the data requirements for Ecological Effects may be waived.

Guide to Use of This Bibliography

1. Content of Bibliography. This bibliography contains citations of all the studies reviewed by EPA in arriving at the positions and conclusions stated elsewhere in this standard. The bibliography is divided into 3 sections: (1) citations that contributed information useful to the review of the chemical and considered to be part of the data base supporting registrations under the standard; (2) citations examined and judged to be inappropriate for use in developing the standard; and (3) standard reference material. Primary sources for studies in this bibliography have been the body of data submitted to EPA and its predecessor agencies in support of past regulatory decisions, and the published technical literature.

2. Units of Entry. The unit of entry in this bibliography is called a "study". In the case of published materials, this corresponds closely to an article. In the case of unpublished materials submitted to the Agency, the Agency has sought to identify documents at a level parallel to a published article from within the typically larger volumes in which they were submitted. The resulting "studies" generally have a distinct title (or at least a single subject), can stand alone for purposes of review, and can be described with a conventional bibliographic citation. The Agency has attempted also to unite basic documents and commentaries upon them, treating them as a single study.

3. Identification of Entries. The entries in this bibliography are sorted by author, date of the document, and title. Each entry bears, to the left of the citation proper, an eight-digit numeric identifier. This number is unique to the citations, and should be used at any time specific reference is required. This number is called the "Master Record Identifier", or "MRID". It is not related to the six-digit "Accession Number" which has been used to identify volumes of submitted data; see paragraph 4(d)(4) below for a further explanation. In a few cases, entries added to the bibliography late in the review may be preceded by a nine-character temporary identifier. This is also to be used whenever a specific reference is needed.

4. Form of the Entry. In addition to the Master Record Identifier (MRID), each entry consists of a bibliographic citation containing standard elements followed, in the case of materials submitted to EPA, by a description of the earliest known submission. The bibliographic conventions used reflect the standards of the American National Standards Institute (ANSI), expanded to provide for certain special needs. Some explanatory notes of specific elements follow:

   a. Author. Whenever the Agency could confidently identify one, the Agency has chosen to show a personal author. When no individual was identified, the Agency has shown an identifiable laboratory or testing facility as author. As a last resort, the Agency has shown the first known submitter as author.

b. Document Date. When the date appears as four digits with no question marks, the Agency took it directly from the document. When a four-digit date is followed by a question mark, the bibliographer deduced the date from evidence in the document. When the date appears as (19??), the Agency was unable to determine or estimate the date of the document.

c. Title. This is the third element in the citation. In some cases it has been necessary for Agency bibliographers to create or enhance a document title. Any such editorial insertions are contained between square brackets.

d. Trailing Parentheses. For studies submitted to us in the past, the trailing parentheses include (in addition to any self-explanatory text) the following elements describing the earliest known submission:

(1) Submission Date. Immediately following the word 'received' appears the date of the earliest known submission.

(2) Administrative Number. The next element, immediately following the word 'under', is the registration number, experimental permit number, petition number, or other administrative number associated with the earliest known submission.

(3) Submitter. The third element is the submitter, following the the phrase 'submitted by'. When authorship is defaulted to the submitter, this element is omitted.

(4) Volume Identification. The final element in the trailing parenthesis identifies the EPA accession number of the volume in which the original submission of the study appears. The six-digit accession number follows the symbol 'CDL', standing for "Company Data Library". This accession number is in turn followed by an alphabetic suffix wihich shows the relative position of the study within the volume. For example, within accession number 123456, the first study would be 123456-A; the second, 123456-B; the 26th, 123456-Z; and the 27th, 123456-AA.

Section I

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